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GLOBAL CLIMATE CHANGE: SEEKING A GLOBAL CONSENSUS

HEARING BEFORE THE COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION UNITED STATES SENATE ONE HUNDRED FIRST CONGRESS

SECOND SESSION

ON

THE SCIENCE OF GLOBAL CLIMATE CHANGE: SEEKING A GLOBAL
CONSENSUS

JUNE 14, 1990

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GLOBAL CLIMATE CHANGE: SEEKING A GLOBAL CONSENSUS

THURSDAY, JUNE 14, 1990

U.S. SENATE,
COMMITTEE ON COMMERCE, SCIENCE AND TRANSPORTATION,
Washington, DC.

The Committee met, pursuant to notice, at 1:05 p.m. in room SR-253, Hon. Albert Gore, Jr. presiding.

Staff members assigned to this hearing: Mike Nelson, professional staff member and Susan Aylward, minority staff counsel.

OPENING STATEMENT BY SENATOR GORE

Senator GORE. The Committee will come to order. I would like to welcome our witnesses and our guests. I have an opening statement, which without objection I will read for the record.

Ever since President Bush took office more than 16 months ago, he has been urged time and again by members of Congress, other world leaders and concerned citizens in this Nation, and in countries around the world to live up to his campaign pledge to protect the environment.

He has been urged to provide leadership in this area. The United States has a unique opportunity to confront the most serious environmental crisis we have ever faced with courage, vision and commitment; the world expects that much from us, and the situation demands that much and more. Unfortunately, that opportunity is now being lost by an Administration that seems to be scared of the facts, blind to the future, unwilling to move forward.

In just the last six weeks, several important events have taken place that seem to make it undeniable that this Administration is building a legacy of environmental inaction and neglect. In mid-April, the White House held a conference on global warming where the President outraged delegates from other nations by failing to recognize the urgency of the problem and by recommending a policy of delay and hesitation, and calling for research instead of action.

The European delegates at that conference wanted to discuss ideas for more concrete and prompt action, but they were completely ignored. Many of the delegates, according to the news reports, were greatly offended because the meeting was orchestrated in a way that only hand-picked U.S. officials could speak and everyone else was silenced. In the end, it was clear to those present that this Administration simply did not intend to cooperate with other nations in developing strategies to protect the world from the threats posed by global warming.

In May it was reported that President Bush had once again made the United States an environmental outcast in the world community. At that time, the topic was the stratospheric ozone layer. There is no dispute about the serious problem we face there. There is no question that the ozone layer is being destroyed by man-made chemicals and that this in turn will lead to increased numbers of skin cancers, damaged crops, more cataracts, damage to the web of life especially in the ocean. Yet despite these findings President Bush instructed U.S. negotiators to oppose efforts supported by nations around the world to protect the stratospheric ozone layer, and with his opposition he began undermining the single most important international agreement to date to protect the world's environment.

Now we have a report that the United States may be once again leading an environmental retreat, this time refusing to cooperate with the rest of the world on how best to confront the challenge of global warming. We are going to learn more about that today, but according to some news reports the President used U.S. influence to dilute a report by the U.N.-sponsored working group that is charged with developing the international response strategies to address global warming.

The report in question is being drafted by the Response Strategies Working Group of the IPCC, the Intergovernmental Panel on Climate Change. Rather than calling for the action-oriented response strategies favored by many other nations involved in the process, the draft report of the working group chaired by the U.S. instead proposes, we are told, no specific goals or timetables for action.

We will find out some more about that today, but let me just take a moment to explain the significance of this action. First, the IPCC is the official forum in which nations from around the world are drafting three important reports on climate change. Working Group I, chaired by the United Kingdom, has prepared a report on the science of climate change, and we are going to have testimony this afternoon from Dr. Robert Watson based upon what that group has been doing.

Another report prepared by Working Group II, which is chaired by the Soviet Union, assesses the impacts to expect from climate change. That will be discussed today by Dr. Alan Hecht. The third report has been prepared by the U.S.-chaired Working Group III, and that is on the response strategies to address climate change, and we are very pleased that Dr. Fred Bernthal is here today to discuss what that group is doing.

Next, it is important to remember that throughout the last year, in numerous Congressional hearings, Administration officials have based the President's inaction on this issue on a desire to postpone decisions on appropriate action until the IPCC scientific assessment is completed. Well, the executive summary of that scientific assessment has been released, and it officially states that the problem is indeed serious, and that stabilizing the level of most greenhouse gases at current levels in the atmosphere will require emissions reductions of 60% or more. Furthermore, it states that the buildup of greenhouse gases will lead to temperature increases of 3 to 8 degrees Fahrenheit by the middle of the next century, and that tem-

perature increases in central North America—the American grain-belt—are predicted to be higher than the global average increase, accompanied on average by reduced summer precipitation and soil moisture. In other words, more heat and drought in the heart of America's agricultural sector.

Finally, in explaining the significance of these latest actions, let me also note that it was at a January 1989 meeting of the Response Strategies Working Group of the IPCC before which Secretary of State James Baker stated “. . . we can probably not afford to wait until all of the uncertainties have been resolved before we do act. Time will not make the problem go away.”

Prime Minister Margaret Thatcher understands this fact. In a May 25th speech, she referred to the IPCC report on the science of climate change and stated that, “. . . greenhouse gases are increasing substantially as a result of man's activities; that this will warm the Earth's surface, with serious consequences for us all, and that these consequences are capable of prediction.” Prime Minister Thatcher went on to say that, “if the Panel's predictions are broadly right, then the world could become hotter than at any time in the last 100,000 years and just to get our perspectives right, can I remind you that Abraham was around only 5,000 years ago!”

As the reports of the IPCC working groups are being completed, the Administration is reportedly attempting to use its influence to exclude recommendations for action. The Administration's foot-dragging is becoming an embarrassment. It is shortsighted and just plain ridiculous. In country after country, policymakers and scientists, and government leaders recognize that we need to take action now. In our country, unfortunately, the President is spending incredible amounts of energy in cynically avoiding the important decisions that must be made. This issue demands leadership from the U.S. If we don't act today, the problems we face tomorrow will be insurmountable.

Let me call our three witnesses now to the witness table: Dr. Robert Watson, Dr. Alan Hecht, and Dr. Fred Bernthal.

Dr. Robert Watson is an atmospheric scientist from NASA's Office of Space Science and Applications. He is a frequent witness before this Committee and others. He was instrumental in determining the causes and extent of the Antarctica ozone hole, and was very involved in the scientific assessments and negotiations that led to the Montreal Protocol on Substances that Deplete the Ozone Layer. Dr. Watson and Dr. Daniel Albritton at NOAA are the official U.S. liaisons to the IPCC Working Group Number I.

Dr. Alan Hecht is the Deputy Assistant Administrator for International Activities at EPA and is the official U.S. liaison to Working Group II of the IPCC, which is assessing the impacts of global warming. Dr. Fred Bernthal is Deputy Director of NSF. Before moving to NSF earlier this year, Dr. Bernthal was Assistant Secretary of State for Oceans, International, Environmental and Scientific Affairs at the Department of State. A physicist by training, Dr. Bernthal serves as Chairman of Working Group III of the IPCC. And one of his most important biographical facts, is that he is a Tennessean, and we are delighted that you are here.

Dr. Bernthal, we committed to try to get you in and out in time for you to get back to the important review going on at NSF.

We do want to have the other two statements first, but I want you to know that we are sensitive to your time constraints and the work that you are doing at NSF. We are honored to have you here. We are going to try to get you back to your other responsibilities as soon as possible.

We are going to hear from each working group now, beginning, Dr. Watson, with you. Your working group has just completed an important draft, and we are looking forward to your testimony. Without objection, your full text will be included in the record, and we invite you to proceed with a presentation of as much of it as you see fit.

I have an opening statement that Senator Hollings would like to have included in the record.

[The statement follows:]

OPENING STATEMENT BY THE CHAIRMAN

I thank Senator Gore for chairing today's hearing of the Commerce Committee on international perspectives on global warming. Over the past two years, the Committee has held more than a dozen hearings on global change and greenhouse warming. The Committee reported, and the Senate passed earlier this year, S. 169, a global change bill I introduced to promote more coordinated and comprehensive global change research. As part of the Committee's continuing efforts on the global change issue, today's hearing will provide us with the opportunity to focus more attention on the activities of the rest of the world.

Clearly global change is an international issue, and addressing it will require international action. Such action will require international cooperation—cooperation on both research and policy.

Today, we will be hearing about the Intergovernmental Panel on Climate Change, the IPCC, which was established to promote such cooperation and to lay the groundwork for action to slow global warming. At this hearing, we will find out how well the IPCC is working. We will hear about the recently completed working group meetings and about the next steps in the IPCC process.

The IPCC has a very difficult task. It must find a way for over fifty countries to agree on the causes and impacts of global warming and, more importantly, on feasible policy options for addressing it. That will not be easy.

In the worse case, in the next century global warming could cause millions of deaths worldwide due to starvation and disease. Even the middle-of-the-road estimates predict trillions of dollars of economic losses—flooded ports and coastland, reduced crop yields, decimated forests, and contaminated water supplies. But the costs of reducing emissions of carbon dioxide and other greenhouse gases will be high as well. According to one estimate, it would cost \$200 billion a year to reduce world emissions of carbon dioxide by twenty percent, and according to the report of IPCC Working Group I, we need to cut carbon dioxide emissions by at least sixty percent to stabilize the concentration of carbon dioxide in our atmosphere.

Negotiating international agreements to address a problem with such huge social and economic impacts will not be easy. Within the IPCC, there are still arguments on whether action is necessary, which make any discussion of specific responses problematic. The IPCC negotiators represent quite diverse economic and governmental interests, which make it difficult to reach a consensus on an issue of such magnitude.

Given these concerns, it will not be easy for the IPCC to make the critical, trillion-dollar decisions that will have to be made if the world is to address the threat of global warming. However, I am heartened by the work that has been done so far. The report of Working Group I provides a very clear, authoritative statement of what we know and what we do not know about global warming. It represents the views of over 300 scientists from around the world, and is a crucial first step toward international action on the problem. We cannot hope to address the problem if there is not international agreement on what the problem is.

Today's hearing will certainly not be the last Commerce Committee hearing on global change. Global warming is a problem which is not going to go away, and the Commerce Committee will continue to have a central role in addressing it. I look forward to reviewing the testimony from the three outstanding witnesses here today.

STATEMENT OF DR. ROBERT T. WATSON, EARTH SCIENCE AND APPLICATIONS DIVISION, OFFICE OF SPACE SCIENCE AND APPLICATIONS, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Dr. WATSON. Thank you, Senator. It is a pleasure, as always, to testify before you. What I would like to do today is to summarize the key findings of the IPCC Working Group I. We tried to differentiate what was certain from what we can calculate with confidence, from what we are only less certain about.

There is no doubt that emissions resulting from human activities are increasing the atmospheric concentrations of many of the key greenhouse gases, primarily carbon dioxide, methane, CFCs and nitrous oxide. This will indeed change the radiative forcing of the earth's atmosphere and will in balance lead to a warming of the earth's atmosphere.

We recognize some of these gases are very long-lived, primarily carbon dioxide, nitrous oxide and CFCs, and so any changes in emissions will only result in slow changes in the atmospheric concentrations, and indeed, with the long-lived gases, if we want to stabilize the concentrations at today's level, it would require between a 60 and an 85 percent reduction compared to today's emissions. So to put it a different way, if we would want to remove all risk of change in the earth's climate, it would require 60 to 85 percent reductions in carbon dioxide, nitrous oxide and CFCs.

We then used the best models we have available and we recognize there are significant scientific uncertainties in these models, especially when we try and predict the magnitude, the timing and the regional patterns. However, the best models to date predict that if we use the so-called IPCC business as usual scenario, which is actually quite consistent with the so-called reference case of Working Group III, which is an analysis of emissions over the next 30 to 40 years, the models would predict an increase of the global mean temperature of around 0.3 degrees Centigrade per decade.

In other words, by about 2025 it would have increased by 1 degree compared to today, increasing about 3 degrees Centigrade by the end of the century. We also note, however, that this rise would not be uniform. It would be subject to changes due to solar variations, volcanic eruptions, et cetera, but the contribution due to anthropogenic activities would be a predicted 0.3 degrees increase per decade.

We also noted that if you could reduce the emissions of these trace gases, the so-called IPCC scenarios B, C and D, one could reduce the rate of increase down to 0.2 or even 0.1 degrees Centigrade per decade, but this would require significant reductions in emissions of carbon dioxides, CFCs and the other greenhouse gases.

We attempted to look at the regional climate changes. Unfortunately, there is consensus that while we can predict changes in regional climate our confidence in those predictions is somewhat low. This is primarily due to the fact that we do not have a good understanding of some of the land surface hydrology processes, and we do not have a good understanding of the rates of uptake of heat by the oceans.

We also note that if there were to be a 0.3 degrees per decade increase in temperature, then sea level would be one of the consequences of that change. There would be increases in sea level of about 6 centimeters per decade. Therefore, by the end of the next century—by the year 2100—we would predict somewhere between 30 and 110 centimeters increase in sea level.

As I stated earlier, the key uncertainties are related to the understanding of the sources of six of the greenhouse gases, especially trying to understand the carbon cycle clouds that affects the magnitude of the predicted climate change, oceans that affect the predicted regional patterns of climate change and the rate of climate change.

Now, we looked very carefully at the temperature record and in our judgment there has been an increase in the air temperature over the globe over the last 100 years of somewhere between 0.3 and 0.6 degrees Centigrade and indeed, five of the warmest years on record have been in the 1980s. We note, however, that the increase was not uniform with time, nor in space.

Now, there are two ways to look at this temperature record. The overall size is indeed broadly consistent with the climate models. These climate models would have predicted somewhere between a half and 1 degree temperature increase from the 1800s to today. However, we noted that natural variability is of the same order of magnitude: therefore the temperature records to date cannot be used to either confirm the greenhouse warming theory or to invalidate the greenhouse warming theory. We also pointed out that unequivocal detection of the greenhouse effect, the enhanced greenhouse effect due to human activities, will probably take at least another decade or more.

With respect to severe or unusual weather, the models at the moment are not good enough to say whether or not severe storms will intensify or will become more frequent. We would believe, however, the locale of those storms is likely to change as the temperature patterns change.

We touched upon ecosystems, and we recognized there are some beneficial and some negative effects of both temperature changes and changes in CO₂, but this was addressed primarily in Working Group II, so I will not add to this.

Overall, there is indeed a belief that we need to improve our predictive capability. This can be done with an aggressive research program: we need to understand the processes that go into the climate models, to obtain the long-term measurements to monitor and document changes in the earth's environment, and improve our predictive capability.

[The statement follows:]

Statement of
 Dr. Robert T. Watson
 Earth Science and Applications Division
 Office of Space Science and Applications
 National Aeronautics and Space Administration
 before the
 Committee on
 Commerce, Science, and Transportation
 U.S. Senate

Mr. Chairman and Members of the Committee:

I am pleased to be here today to discuss the international Scientific Assessment of Climate Change conducted under the auspices of Working Group I of the Intergovernmental Panel on Climate Change (IPCC), which was sponsored by the World Meteorological Organization (WMO) and the United Nations Environment Program (UNEP).

This testimony will briefly present the background, participation, scope, review process, timetable, assessment outline, relation to policy, and executive summary of the IPCC scientific assessment (the executive summary appended to this testimony is verbatim from the IPCC assessment).

The dramatic rise in world population and industrial activities during the last century has generated concern that human activities are affecting the global environment. In particular, one global environment change which may affect both human well being and the quality of life is global warming; warming caused by increasing atmospheric concentrations of radiatively active trace gases such as carbon dioxide, methane, nitrous oxide, chlorofluorocarbons and tropospheric ozone. Although significant scientific uncertainty remains about the contribution of human activities, this environmental issue is no longer the sole concern of the scientific community and environmental groups, but its importance has now been recognized by governments around the world. The current interest in the global climate change issue has resulted in the endorsement, at the highest levels of governments, for comprehensive scientific, technical and economic assessments to be performed. The IPCC assessments are in response to the need for such assessments.

Background

The World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) sponsored the Intergovernmental Panel on Climate Change (IPCC) to produce an international, state-of-the-knowledge review of climate change. This review includes three companion IPCC assessments of global climate change: (i) science, (ii) socio-economic impacts, and (iii) response strategies. The IPCC assigned lead responsibilities for the preparation of the three assessments reports as follows: (i) Science - United Kingdom; (ii) Socio-Economic Impacts - USSR; and (iii) Response Strategies - USA.

The scientific assessment of climate change is a peer-reviewed scientific document written by world renowned scientists, accompanied by a "Policymakers Summary" which is directed to government officials. The scientific assessment was completed, and the executive summary released, on May 25, 1990. The policymakers summary and the main assessment were delivered to the IPCC secretariat June 4, 1990.

Participation

The Scientific Assessment of Climate Change was chaired by Dr. J. Houghton, Director General of the British Meteorological Office, and prepared and peer-reviewed by the most knowledgeable scientists in the world on this subject. About 250 scientists participated in the preparation of the assessment, with an additional comparable number conducting the peer review. The assessment was coordinated, and initial drafts of the policymakers summary and its executive summary prepared, by a small core team of scientists at Bracknell, UK. I represented the U.S. as a member of this core team. The lead authors were selected by the intergovernmental IPCC Science Working Group (WG I), and were responsible for the preparation of their sections. Daniel Albritton (NOAA) and I (NASA) were the U. S. Representatives on the IPCC Science Working Group on behalf of the Committee on Earth and Environmental Sciences (CEES).

Scope

The main features of the Scientific Assessment of Climate Change are the following:

- o The scope encompassed the full climate change phenomenon, namely: climate forcing agents; processes involved in climate change; climate model formulation; tests of climate models; simulation of past climate changes; predictions of future climate; past climate record; and, physical (sea level) and biological responses to climate change.
- o A special emphasis throughout the assessment was an identification of gaps in the knowledge and a better quantification of uncertainties.

Review Process

The scientific assessment was subjected to several levels of peer review, as outlined in the timetable below. The assessment (the main assessment, the policymakers summary and its executive summary) was peer reviewed both formally and informally by the international scientific community. This was followed by an intergovernmental review of the policymakers summary and its executive summary to ensure consistency between the main assessment and these two summaries.

Timetable

The major events and milestones for the Scientific Assessment of Climate Change included:

9 - 11 Nov 1988	First meeting of the IPCC held to establish the goals, scope, chairs, and schedule of all three assessments. (Geneva, Switzerland)
24 - 26 Jan 1989	First plenary meeting of the Science Working Group (WG 1) held to: establish the features of the Scientific Assessment of Climate Change; select lead authors; and, evaluate required interactions with the other IPCC Working Groups. (Oxford, United Kingdom)
7 - 8 March 1989	Meeting of lead authors of the Scientific Assessment of Climate Change met to establish: the detailed structure and contents of the Assessment; the participants; and, the schedule of working meetings. (Princeton, USA)
April 1989 - Jan 1990	Subgroup meetings held to draft the individual sections of the Assessment.
Dec 1989 - Jan 1990	Section drafts available for initial informal peer review by the international scientific community.
Feb 1990	Second draft of assessment sections integrated into complete report, and an initial policymakers and executive summary prepared and distributed to lead authors and a small core review group.
26 Feb - 2 Mar 1990	Meeting of the lead authors of the Science Working Group and limited number of other experts (two per section) held to review the second draft of the Assessment (including policymakers summary and its executive summary). (Edinburgh, United Kingdom)
2 - 11 Mar 1990	Lead authors redraft assessment based on reviewers comments.
12 Mar - 9 April 1990	Third draft of the Assessment, including the policymakers summary and its executive summary, is distributed to the international scientific community for the second stage formal peer review.
10 - 27 April 1990	Lead authors revised assessment based on peer review comments.
7 - 18 May 1990	Governmental review of "final" version of assessment conducted, (primarily the policymakers summary and its executive summary).
21 - 25 May 1990	Second plenary meeting of the Science Working Group (WG 1), with lead authors, held to review the "final" draft Scientific Assessment of Climate Change. (Windsor, United Kingdom)
4 June 1990	Final Scientific Assessment of Climate Change delivered to IPCC secretariat.
27 - 30 Aug 1990	Approval of the combined IPCC WG Reports (Sweden)
12 - 16 Nov 1990	Second World Climate Conference scheduled, at which the reports of the IPCC will be presented. (Geneva, Switzerland)

Assessment outline.

The Scientific Assessment of Climate Change has eleven sections and an annex.

- Section 1. Greenhouse Gases and Aerosols**
Lead Authors: Watson (USA), Siegenthaler (Switzerland), Oeschger (Switzerland), and Rodhe (Sweden).
- Section 2. Radiative Forcing of Climate**
Lead Authors: Shine (UK), Morcrette (France), Derwent (UK), and Wuebbles (USA).
- Section 3. Processes and Modelling**
Lead Authors: Cubasch (FRG) and Cess (USA).
- Section 4. Validation of Climate Models**
Lead Authors: Gates (USA), Rowntree (UK), and Zeng (PRC).
- Section 5. Equilibrium Climate Change**
Lead Authors: Mitchell (UK), Tokioka (Japan), Manabe (USA), and Meleshko (USSR).
- Section 6. Time-Dependent Greenhouse-Gas-induced Climate Change**
Lead Authors: Bretherton (USA), Bryan (USA) and Woods (UK).
- Section 7. Observed Climate Variations and Change**
Lead Authors: Folland (USA), Karl (USA), and Vinnikov (USSR).
- Section 8. Detection of the Greenhouse Effect in the Observations**
Lead Authors: Wigley (UK) and Barnett (USA).
- Section 9. Sea Level Rise**
Lead Authors: Warrick (UK) and Oerlemans (Netherlands).
- Section 10. Effects on Ecosystems**
Lead Authors: Mellilo (USA), Salati (Brazil), Sinha (India), and Woodward (UK).
- Section 11. Narrowing the Uncertainties**
Lead Authors: McBean (Canada) and McCarthy (USA)
- Annex. Climatic Consequences of Emissions**

Relation to Policy

The purpose of the IPCC was to provide international policymakers with a state-of-the-knowledge assessment of the science of Climate Change. As such the Scientific Assessment of Climate Change is an important scientific document in several respects:

- o It presents a strong, single, concise statement from the global change scientific community.*

In the Assessment, major representatives of the global change scientific community spoke at one forum regarding the knowns and unknowns of climate change, including global warming. The Assessment can, therefore, serve as a common reference point in contrast to sporadic and separate statements reflecting the opinions of individuals. However, even though the assessment represents a general consensus of views of the global change scientific community, there likely will be some scientific viewpoints that fall outside the ranges of the assessment.

- o It is an international scientific assessment.*

The assessment reflects the work of an international group of scientists as opposed to only several national statements.

- o The scientific scope is broad.*

The Assessment provides a summary of the current scientific understanding of the whole climate change phenomenon, ranging from the causes of change to the physical and biological responses to that change.

- o Both natural variability of climate change as well as human-induced climate change were considered.*

In contrast to considering only the potential perturbation of climate by human activities, the Assessment placed predicted change resulting from anthropogenic sources in the context of the observed and predicted changes that are a natural part of the climate system. The comparison of the two affords greater insight into the significance of any predicted human-induced perturbations.

- o The focus on identifying gaps in the knowledge and quantifying uncertainties will aid risk analysis.*

There is a highly relevant difference between (a) "The predicted range of possibilities is from X to Z, with a best estimate of Y" and (b) "The prediction is Y" with regard to decision making; the first statement explicitly reflects the existence of uncertainties in the prediction.

- o The assessment reflects the current state of scientific knowledge.*

The pace of scientific research in this field has been accelerated rapidly in recent years, resulting in the need to be continually cognizant of new knowledge.

Finally, I would reiterate that the scope of the assessment was limited to science issues. The question of impacts and response strategies, both mitigation and adaptation, must also be considered by policymakers. In addition, the economic and other human implications both of

climate change and of the potential response strategies which might be made to such change are of critical concern to policymakers.

Executive Summary

The Executive Summary of the Scientific Assessment of Climate Change was released on May 25, 1990. It summarizes the state of knowledge concerning global climate change, notes the uncertainties associated with our current knowledge, offers predictions and judgements relating to global change, and provides an overview of the areas in which we must improve our predictive capacity. The Executive Summary has been carefully scrutinized to assure that its statements accurately reflect the main assessment. A verbatim copy of the Executive Summary is appended to my testimony.

Conclusions

I believe that the IPCC scientific assessment represents a strong, concise statement from the international scientific community. It will provide an important scientific basis for international discussions. The assessment concluded that: (i) there is no doubt that human activities are causing the atmospheric concentrations of greenhouse gases, particularly carbon dioxide, methane, the chlorofluorocarbons, and nitrous oxide to increase; (ii) current models predict that with the IPCC Business As Usual scenario (also referred to by WG #3 as the 2030 High Emissions Scenario) of future trace gas emissions, the Earth's global mean temperature is likely to increase at a rate of between 0.2 to 0.5 degrees centigrade per decade; (iii) there are many uncertainties in our scientific knowledge, particularly with respect to our ability to predict the magnitude, timing, and regional patterns of climate change (these arise largely from uncertainties associated with the sources and sinks of greenhouse gases, and with the representation of clouds, the oceans, and other feedback mechanisms in the models); (iv) while the Earth's global mean temperature has increased between 0.3 and 0.6 degrees centigrade over the last 100 years, that this observed increase cannot be used to either validate or invalidate the "global warming" hypothesis, because while the magnitude of the observed warming is broadly consistent with the predicted global warming due to the increased concentrations of greenhouse gases, it is also comparable to natural variability, and (v) to improve our predictive capability we need to understand better the processes associated with clouds, oceans, and the carbon cycle, and to establish long-term systematic observations of climate-related variables.

Intergovernmental Panel on Climate Change Working Group I

SCIENTIFIC ASSESSMENT OF CLIMATE CHANGE

Report to IPCC, 25 May 1990

Executive Summary

We are certain of the following:

- there is a natural greenhouse effect which already keeps the Earth warmer than it would otherwise be.
- emissions resulting from human activities are substantially increasing the atmospheric concentrations of the greenhouse gases: carbon dioxide, methane, the chlorofluorocarbons and nitrous oxide. These increases will enhance the greenhouse effect, resulting on average in an additional warming of the Earth's surface. The main greenhouse gas, water vapour, will increase in response to global warming and further enhance it.

We calculate with confidence that:

- some gases are potentially more effective than others at changing climate, and their relative effectiveness can be estimated. Carbon dioxide has been responsible for over half the enhanced greenhouse effect in the past, and is likely to remain so in the future.
- atmospheric concentrations of the long-lived gases (carbon dioxide, nitrous oxide and the CFCs) adjust only slowly to changes in emissions. Continued emissions of these gases at present rates would commit us to increased concentrations for decades to centuries. The longer emissions continue to increase at present day rates, the greater reductions would have to be for concentrations to stabilise at a given level.
- the long-lived gases would require immediate reductions in emissions from human activities of over 60% to stabilise their concentrations at today's levels; methane would require a 15-20% reduction.

Based on current model results, we predict:

- under the IPCC Business-as-Usual (Scenario A) emissions of greenhouse gases, a rate of increase of global mean temperature during the next century of about 0.3°C per decade (with an uncertainty range of 0.2°C to 0.5°C per decade); this is greater than that seen over the past 10,000 years. This will result in a likely increase in global mean temperature of about 1°C above the present value by 2025 and 3°C before the end of the next century. The rise will not be steady because of the influence of other factors.
- under the other IPCC emission scenarios which assume progressively increasing levels of controls, rates of increase in global mean temperature of about 0.2°C per decade (scenario B), just above 0.1°C per decade (scenario C) and about 0.1°C per decade (scenario D).
- that land surfaces warm more rapidly than the ocean, and high northern latitudes warm more than the global mean in winter.
- regional climate changes different from the global mean, although our confidence in the prediction of the detail of regional changes is low. For example, temperature increases in Southern Europe and central North America are predicted to be higher than the global mean, accompanied on average by reduced summer precipitation and soil moisture. There are less consistent predictions for the tropics and the southern hemisphere.
- under the IPCC Business as Usual emissions scenario, an average rate of global mean sea level rise of about 6cm per decade over the next century (with an uncertainty range of 3 - 10 cm per decade), mainly due to thermal expansion of the oceans and the melting of some land ice. This amounts to a rise of about 20cm in global mean sea level by 2030, and 65cm by the end of the next century. There will be significant regional variations.

There are many uncertainties in our predictions particularly with regard to the timing, magnitude and regional patterns of climate change:

- sources and sinks of greenhouse gases, which affect predictions of future concentrations
- clouds, which strongly influence the magnitude of climate change
- oceans, which influence the timing and patterns of climate change
- polar ice sheets which affect predictions of sea level rise

These processes are already partially understood, and we are confident that the uncertainties can be reduced by further research. However, the complexity of the system means that we cannot rule out surprises.

Our judgement is that:

- Global - mean surface air temperature has increased by 0.3°C to 0.6°C over the last 100 years, with the five global-average warmest years being in the 1980s. Over the same period global sea level has increased by 10-20cm. These increases have not been smooth with time, nor uniform over the globe.
- The size of this warming is broadly consistent with predictions of climate models, but it is also of the same magnitude as natural climate variability. Thus the observed increase could be largely due to this natural variability; alternatively this variability and other human factors could have offset a still larger human-induced greenhouse warming. The unequivocal detection of the enhanced greenhouse effect from observations is not likely for a decade or more.
- There is no firm evidence that climate has become more variable over the last few decades. However, with an increase in the mean temperature, episodes of high temperatures will most likely become more frequent in the future, and cold episodes less frequent.
- Ecosystems affect climate, and will be affected by a changing climate and by increasing carbon dioxide concentrations. Rapid changes in climate will change the composition of ecosystems; some systems will benefit while others will be unable to migrate or adapt fast enough and may become extinct. Enhanced levels of carbon dioxide may increase productivity and efficiency of water use of vegetation. The effect of warming on biological processes, although poorly understood, may increase the atmospheric concentrations of natural greenhouse gases.

"To improve our predictive capability, we need:

- to **understand** better the various climate-related processes, particularly those associated with clouds, oceans and the carbon cycle
- to **improve** the systematic observation of climate-related variables on a global basis, and further investigate changes which took place in the past
- to **develop** improved models of the earth's climate system.
- to **increase** support for national and international research activities, especially in developing countries
- to **facilitate** international exchange of climate data

Senator GORE. Thank you. Just to summarize briefly, your group, Working Group I, reported officially that you, after a great deal of study, came to a conclusion that the scientists of the world working on assessing the problem are absolutely certain that emissions resulting from human activities are substantially increasing the atmospheric concentrations of greenhouse gases. These increases will enhance the greenhouse effect, resulting on average in an additional warming of the earth's surface. You used the word "certain", "we are certain of this".

Also, that the main greenhouse gas, water vapor, will increase in response to global warming and further enhance it.

You further calculated with confidence that the long-lived gases would require immediate reductions in emissions from human activities of over 60 percent to stabilize their concentrations at today's levels.

You said further here today, 60 to 85 percent.

So you are certain the problem is real, and you calculate with confidence that reductions in current emissions would have to be in the 60 to 85 percent range.

Now Dr. Hecht, Working Group II, has not yet gotten to the stage that Working Group I has, but we are delighted to have you here to give us a report on exactly where you stand and how your working group is doing.

STATEMENT OF DR. ALAN D. HECHT, DEPUTY ASSISTANT ADMINISTRATOR FOR INTERNATIONAL ACTIVITIES, ENVIRONMENTAL PROTECTION AGENCY

Dr. HECHT. Thank you, Senator and ladies and gentlemen. Actually, let me preface my remarks with respect to Working Group II with just a general remark about the progress of the three groups, because we are at a point now where all of the three working groups have completed their activities. In the case of Working Group II we had our meeting a week and a half ago in Moscow. We completed the material and draft there, but it is the responsibility of the co-chair, Australia, to complete the report and put it in the right format. That is still going on right now. We have, therefore, only the rough draft material that we left Moscow with.

The same is true for Working Group III which last week completed their work in Geneva. All three of these reports are subject to the final IPCC report which will be prepared next week or the week after in Geneva.

Working Group II, Mr. Chairman, had the difficult task of trying to evaluate the potential implications of climate change, both the environmental implications and its social and economic implications. At the very first meeting it confronted the difficult problem of what scenarios or what input it should use to help determine impacts of climate change. Because Working Groups I, II and III worked in parallel, we relied almost exclusively in beginning our work on the body of literature of scenarios that had been produced over the last several years.

To a large extent, the work of Working Group I reaffirms the projections of the general circulation models that have been in the literature. In one area, in the case of projections of sea level rise,

the Working Group I reassessment of new information provide a range of estimates that is somewhat less than the body of literature upon which impact assessments have been drawn. Specifically, Working Group I projects ranges of sea levels well below a meter by the end of the century, whereas the body of literature upon which a great deal of sea level impact assessment work is drawn, is based on a meter or more.

Before I reach the conclusions, I want to make a general comment about the process because I think it is extremely important to understand how the body of the report was put together, the number of countries involved, and the numbers of experts that were asked to participate.

There were six major chapters, and they are defined in the testimony, ranging from agriculture to ecosystems, hydrology and water, energy transport, oceans, and snow and ice. Each was the responsibility of a different country. Each country had the responsibility of soliciting as much input as it could from experts around the world.

In the case of agriculture, which was led by the United Kingdom, over 49 individual contributors from many, many countries around the world provided input on the basis of what they perceived as the assessments given these ranges of scenarios in their particular regions.

Similarly, each of the other chapter authors led by different countries followed the same process. In the end, each of the lead authors produced a chapter which became the subject of review by many countries. In the United States alone we subjected the entire report of all the chapters to considerable peer review and returned each of those reviews to the lead authors for their final assessment.

The end report which was reviewed in Moscow only two weeks ago, therefore, carries with it the significant input not only of the contributors but a healthy extent of review by many countries around the world.

From that body of reports, these six chapters, an executive summary was written, and as soon as that executive summary is finalized by the Australians we will submit it to you for the record. That summary for policymakers tries to capture the conclusions of the report in each of these chapters.

It is difficult in a short period of time to capture all of the results, but let me highlight several, much more of which is described in my testimony. The entire report is a composite list of what could happen under a range of scenarios largely compatible with the work of Working Group I but in some cases beyond the range of Working Group I.

It is not certain that any of these will happen. The difficulty lies in the fact that there are no reliable estimates of regional prediction from which detailed scenarios can be developed. Nevertheless, it is the consensus of the group that there is sufficient risk involved in these reports, particularly in regions which are now subject to stress or low-lying regions or regions which are subject to natural hazards, whether it be coastal or severe storm or others, and that these risks are likely to increase.

The report emphasizes that one of the most important factors is the rate of climate change, and that will determine to a large

extent the degree to which the biosphere, ecosystems and individual species are able to respond. The information from Working Group I in their reassessment indicates that the rates of change are large and likely to exceed anything that we have seen in the last 10,000 years. Under this assumption, the chapter on ecosystems it is stated that this rate of change would pose some risk to large ecosystems.

In general, the report tries to be balanced in presenting where there are positive or likely positive impacts and where there are negative impacts. The report, based largely on the literature, has failed to provide any real economic analysis. The time constraints, the difficulty of working under the various authors, and the available literature on the subject preclude detailed economic analyses measuring both the positive and negative impacts.

The report also deals in only a cursory way with some of the potential social impacts. These are tasks that will have to be expanded upon in some future work.

Mr. Chairman, the activities of this entire group in trying to reassess the literature and in some cases adding some additional material have largely reinforced the body of literature that a litany of serious consequences could result if the ranges of these scenarios are achieved.

By comparison, the reports as compared to the EPA report on climate impacts for the United States which was passed to Congress only last year and which only focuses on the United States are largely compatible in making the same general statements about the need for regional prediction, the same approach to the problem in terms of using the scenarios to derive sensitivities of the ecosystems, the same emphasis on rates of change as being important in ecosystems, water management and the like.

Perhaps the most important consequence now to follow in this report is that it be widely disseminated, that the information be widely shared, particularly with developing countries. This is true not only for this report but for Working Group I because in the course of preparing this report and in dealing with the many countries involved, it is clear that not everyone has a good appreciation of the limitations and uncertainties that underscore both the science and its potential impacts.

One of the great benefits, I think, of this whole process, Mr. Chairman, will be to make these reports clear, make them available, and make individual countries struggling with this issue have a better sense of the overall strengths and weakness of the available information.

Thank you, sir.

[The statement follows:]

TESTIMONY OF
ALAN HECHT
DEPUTY ASSISTANT ADMINISTRATOR
OFFICE OF INTERNATIONAL ACTIVITIES
U.S. ENVIRONMENTAL PROTECTION AGENCY
BEFORE THE
SENATE COMMITTEE ON COMMERCE, SCIENCE,
AND TRANSPORTATION
UNITED STATES SENATE

June 14, 1990

Good afternoon, Mr. Chairman and members of the Committee. My name is Alan Hecht, and I am Deputy Assistant Administrator for International Activities at the U.S. Environmental Protection Agency. It is with great pleasure that I appear before you today to testify on the views of the international scientific community regarding global climate change. I understand that you are specifically interested in the recent findings of Working Group II under the Intergovernmental Panel on Climate Change (IPCC). Since the beginning of the IPCC I have served as coordinator of U.S. activities related to Working Group II.

The Intergovernmental Panel on Climate Change (IPCC)

Chaired by Dr. Bert Bolin of Sweden, the IPCC was established in 1988, under the joint auspices of the United Nations Environment Program (UNEP) and the World Meteorological Organization (WMO), to oversee internationally coordinated assessments of the current knowledge of the science, impacts, and response options of climate change. At the IPCC's first meeting in November 1988, the Panel set up three working groups to carry out this work:

- (1) the scientific assessment working group chaired by the United Kingdom (WG-I);

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- (2) the impact assessment working group chaired by the Soviet Union (WG-II); and
- (3) the response strategies working group (RSWG) chaired by the United States (WG-III).

The United States has been an active participant in all three working groups, which have met on numerous occasions over the last couple of years to continue their work. I have just returned from the final meetings of the WG-II in Moscow and WG-III in Geneva. The IPCC will release its first assessment report following its fourth plenary in August 1990.

Organization of Working Group II

As I just mentioned, Working Group II (WG-II) on Impacts was charged with describing the environmental and socio-economic implications of possible climate changes over the next decades due to increasing concentrations of greenhouse gases in the atmosphere.

The U.S.S.R. chaired this group with Japan and Australia serving as vice-chairs. Scientists from approximately 10 countries were the lead authors of the report (Table 1), with dozens of scientists around the world contributing material. Over 30 countries and organizations [e.g. OPEC and FAO] attended the final meeting in Moscow, May 28-31, where the report was adopted by the working group.

Because of the short time frame, work among all groups had to proceed in parallel. As a result, WG-II was forced to use a number of scenarios based on existing models and analyses in the literature. These scenarios were largely drawn from the Villach

Report and several reports by the National Research Council, and have the features of:

- o doubling of the radiatively equivalent to CO_2 in the atmosphere between now and 2025 and 2050 of the greenhouse gases;
- o an eventual increase of global mean temperature of 1.5°C to 4.5°C above pre-industrial values;
- o an unequal global distribution of this temperature rise, namely a temperature increase of half the global mean in the tropical regions and twice the global mean in the polar regions;
- o a sea level rise of 0.3 to 0.5m by 2050 and about 1.0m by 2100.

The temperature scenarios compare reasonably well with the latest assessment of WG-I of an effective doubling of CO_2 for the IPCC "business as usual scenario."¹ This would lead to a mean global temperature increase of about 1°C above the present value by 2025 and about 3°C before the end of the next century.

The sea level scenarios used by WG-II are, however, higher than current estimates given by WG-I. WG-I projects a rise of about 20 cm by 2030 and 65cm by the end of the next century under the high emissions scenario. Each of these estimates would be characterized by significant regional variations. The assessment literature is largely based on assuming a sea level rise of 50 to 200 cms (2 meters), generally over shorter time periods.

¹ This scenario assumes that few or no steps are taken to limit greenhouse gas emissions. Current energy use and levels of tropical forests clearing continue and fossil fuels, particularly coal, remain the world's primary energy source.

I emphasize that the majority of the analysis done by WG-II reflects analysis of the available literature as opposed to new and in depth original studies. This literature reflects a wide variety of methodologies. The report does not critically review existing methodologies.

The studies in this report also generally assume current societal, technological and environmental conditions. Some studies assume natural adaptation or some limited societal response. Such factors as changes in technology, which would effect sensitivity to climate change, are usually not considered.

In general, effects studies must rely on regionally detailed climate forecasts in which there is little confidence at present (see WG-I report). Thus the results in the WG-II report are best described as environmental sensitivity studies with respect to a range of climate scenarios.

A difference in approach between WG-I and WG-II centers around the use of paleoclimate scenarios as "predictors" of future climates. Paleoclimate analogs are proposed by Soviet Scientists as a means by which future climate can be predicted. The methodology assumes that past warm geologic intervals provide insight into possible future climate conditions. By contrast, general circulation models (GCMs) are based on mathematical representation of the physical processes in the atmosphere and the interactions of the atmosphere with the earth's surface and oceans.

There is considerable scientific debate about the merits and demerits of each of these as discussed in the report of WG-I.²

WG-II has chosen to use both GCM and paleoanalog scenarios as a basis for its impact assessments (except for sea level rise). These scenarios provide a different set of boundary conditions which in some cases, e.g., in agriculture, give different results.

While the report recognizes the importance of rate of climate change as a major societal factor, the subject is not discussed in

² The scientific basis for paleoanalogs is described in the book Anthropogenic Climate Change (in Russian) edited by M. Budyko and Y. Izrael. The English version will be published by University of Arizona Press in 1990. Budyko is the leading proponent of this theory which has its critics in the USSR and elsewhere. The basic argument is that past warm intervals, especially, the Holocene (5000-6000 years ago), the Eemian (125,000 years ago) and the mid-Pliocene (about 4-5 million years ago) represent times when the global average temperatures were respectively 1°, 2° and 4°C above the present. Budyko also believes that the CO₂ levels in the atmosphere were near 550 ppm in the Pliocene, an issue disputed by the WG-I report. Assuming that the intervals can serve as models of the future, Soviet scientists have attempted to reconstruct the spatial patterns of past temperature and precipitation (mainly for the USSR) for each period. They conclude that the spatial patterns are similar for all of these intervals. From this analysis, Budyko concludes that the overall climate effect is largely beneficial with abundant precipitation occurring in areas now relatively dry.

Outside of the USSR, this approach is not widely accepted. A two year cooperative US-USSR effort, under the US-USSR Environmental Agreement, to evaluate this approach has been underway and the results of this study will be published in a book, Prospects of Future Climate Change (1990) edited by M. MacCracken and Alan Hecht (US) and M. Budyko and Y. Izrael (USSR). Further testing and evaluation of this approach is underway. IPCC WG-I in their evaluation concludes: "We cannot therefore advocate the use of paleoclimates as predictions of regional climate change due to future increases in greenhouse gases...". Largely at the request of IPCC WG-II Chairman, WG-II has included impacts based on paleoclimate scenarios in its reports.

detail. Finally, while the report was intended to deal with both environmental and economic impacts, the report contains very little economic analyses.

Extensive reviews of the full WG-II report were conducted by Canada, U.K. and Australia. In the U.S., over 30 scientists reviewed the report in addition to a review panel organized under the leadership of the National Climate Program Office (NCPO) with support from the National Oceanic and Atmospheric Administration (NOAA). These reviews were sent to lead authors to assist them in preparing their final chapters.

Major Conclusions

- o The major conclusion of Working Group-II is that the projected climate changes of the "business as usual" scenario are likely to have significant impacts on a broad range of managed and unmanaged ecological systems with the greatest impacts on those regions exposed to natural hazards, or under environmental or economic stress. While on balance, the evidence is that food production at the global level can be maintained at essentially the same level as would have occurred without climate change, the cost of achieving this is unclear. There may, however, be severe effects in some regions, particularly those with high present day vulnerability. The inability to provide detailed regional scenarios of climate change limits the ability to adequately estimate potential regional impacts.
- o The rotation period of forests is long and current forests will grow mature and decline during a climate in which they are increasingly more poorly adapted. Actual impacts depend on the physiological adaptability of trees and a range of biological relationships (e.g. parasites, competition, etc.). Large losses in the form of forest declines from both factors can occur. The most sensitive areas will be where species are close to their biological limits in terms of temperature and moisture.

- o The rate of projected climatic changes is the major factor determining the type and degree of climatic impacts on natural terrestrial ecosystems. Under the WG-III "business as usual" scenario of future trace gas emissions, current models predict that the global mean annual temperature is likely to increase at a rate of 0.2-0.5°C per decade. This rate of increase is greater than seen over the past 10,000 years. These rates are likely to be faster than the ability of some species to respond.

Some species could be lost due to increased stress leading to a reduction in global biological diversity. Most at risk are those communities in which the options for adaptability are limited (e.g., montane, alpine, polar, island and coastal communities, remnant vegetation, and heritage sites and reserves) and those communities where climate changes add to existing stresses.

- o Relatively small concomitant changes can cause large water resource problems in many areas, especially arid and semi-arid regions and those humid areas where demand or pollution has led to water scarcity. Little is known about regional details of greenhouse gas-induced hydrometeorological change. It appears that many areas will have increased precipitation, soil moisture and water storage, thus altering patterns of agriculture, ecosystems and other water use. Water availability will decrease in other areas, a most important factor for already marginal situations, such as the Sahelian zone in Africa.
- o The most vulnerable human settlements are those especially exposed to natural hazards, e.g., coastal or river flooding, severe drought, landslides, severe wind storms and tropical cyclones. The most vulnerable populations are in developing countries, in the lower income groups, residents of coastal lowlands and islands, populations in semi-arid grasslands, and the urban poor in squatter settlements, slums and shanty towns, especially in megacities. In coastal lowlands such as in Bangladesh, Viet Nam, Egypt, and China as well as in small island nations, inundation due to sea level rise and storm surges could lead to significant movements of people. Major health impacts are possible, especially in large urban areas, due to changes in availability of water and food and increased health problems due to heat stress spreading of infections. Changes in precipitation and temperature could radically alter the patterns of vector-borne and viral diseases by shifting them to higher latitudes and thus put large populations at risk. These changes could initiate, as similar events have in the past, large migrations of people leading over a number of years to severe disruptions of settlement patterns and social instability in some areas.

- o A 30-50 cm sea level rise (projected by 2050) would contaminate the water supply of several atoll nations such as the Marshall Islands and the Republic of Maldives, and threaten tourist beaches around the world. A 1 m rise by 2100 or later would render some island states uninhabitable, displace tens of millions of people, seriously threaten low-lying urban areas, flood productive land, contaminate fresh water supplies and change coastlines. Coastal protection would involve very significant costs (see WG-III Report). Rapid sea level rise would change coastal ecology and threaten many important fisheries.
- o Reductions in sea ice will benefit shipping, but seriously impact ice-dependent marine mammals and birds. Impacts on the global oceans will include changes in the heat balance, shifts in ocean's capability to absorb heat and CO₂, and changes in upwelling zones associated with fisheries. Effects will vary by geographic zones, with changes in habitats and a decrease in biological diversity and shifts in marine organisms and productive zones, including commercially important species. Such regional shifts in fisheries will have major socio-economic impacts.
- o The global areal extent and volume of elements of the terrestrial cryosphere (seasonal snow cover, near-surface layers of permafrost and some masses of ice) will be substantially reduced. These reductions, when reflected regionally, could have significant impacts on related ecosystems and social and economic activities.
- o Permafrost, which currently underlies 20-25% of the land mass of the Northern Hemisphere, could experience significant degradation within the next 40-50 years. Projected increases in the thickness of the freeze-thaw (active) layer above the permafrost and a recession of permafrost to higher latitudes and altitude could lead to increases in certain instability, erosion and landslides in those areas which currently contain permafrost. As a result, overlying ecosystems could be significantly altered and the integrity of man-made structures and facilities reduced thereby influencing existing human settlements and development opportunities.

Recommendations for Future Impact Studies

IPCC WG-II was unable to address one aspect of its mandate, namely an analysis of likely social-economic impacts of climate

change. This remains a major task for the future. The available literature on economic impacts is diverse and subject to considerable controversy. A great deal of future work is needed to provide credible economic analyses of possible impacts.

Other areas where the Working Group has identified the need for additional work are:

- o Improved knowledge of effects of changes in climate on crop yields and livestock productivity in different regional situations and under different types of management.
- o Better understanding of response of ecosystems to different rates of climate change.
- o Mapping of low coastal areas subject to inundation from sea level rise of various magnitudes with particular stress on regional and local conditions (e.g., land subsidence) that will amplify the impacts.

Analysis of Overall IPCC Process

Let me make some observations on the overall IPCC effort, and in particular the activities of WG-II. The IPCC has been successful in a number of ways:

- o It has drawn governments into an active debate on climate change issues.
- o It has identified crucial policy and technical issues for future debate.
- o It has created a number of informal networks and channels of communications among scientists and between governments.
- o It has established a common framework, based on the assessment reports which governments can use in preparing for negotiations of a framework convention.

While the IPCC has encouraged the active participation of existing international institutions (e.g. IIASA, OECD), future

activities might more actively draw on the excellent technical capabilities of these organizations.

Many existing organizations have experience in climate impact studies and can make significant contributions to improving existing methodologies in this field.

Finally, Mr. Chairman, an important task facing the IPCC following the completion of the First Assessment report is the dissemination of the conclusions of the IPCC reports to all countries. Presentations of the IPCC results in easily understood ways would greatly increase appreciation of the strengths and weaknesses of the current understanding of climate change and its potential impacts on society.

Thank you; I appreciate having been given the opportunity to discuss these important issues. I would be happy to address any questions which you may have at this time.

TABLE 1

<u>Chapter</u>	<u>Lead Country Authors*</u>
Agriculture and Forestry	U.K., U.S.S.R., India (49)
Natural Terrestrial Ecosystem	Canada, U.S.S.R., U.S. (17)
Hydrology and Water Resources	U.S., U.S.S.R., Algeria (N.A.)
Human Settlement, Energy Transport, Industry, Health	Japan, U.S. (31)
Oceans and Coastal Zones	U.S.S.R., U.S. (28)
Snow Cover, Ice and Permafrost	Canada, U.S.S.R. (28)

* Numbers in () are expert contributions for sections of the report. Countries which contributed material include (other than those listed above) Australia, Benin, Brazil, Ethiopia, Costa Rica, Czechoslovakia, East Germany, Finland, FRG, Hungary, Ireland, Israel, Kenya, Netherlands, New Zealand, Nigeria, Norway, Mexico, Philippines, PRC, Poland, Thailand, U.K., Vietnam. Other contributing organizations included: OECD and IIASA.

**STATEMENT OF DR. FREDERICK M. BERNTHAL, DEPUTY
DIRECTOR, NATIONAL SCIENCE FOUNDATION**

Dr. BERNTHAL. Thank you, Senator. I do appreciate you and your staff's attempts to accommodate the important agenda and business of the National Science Board today. I confess there is a certain indisputable logic to hearing about the problem before we hear about the solution, so I am pleased to testify.

I also wanted to point out that the testimony that you have was necessarily late in arriving here today for reasons that you well understand.

As you point out, I did head the U.S. delegation and chaired the meeting of the Response Strategies Working Group last week in Geneva, and at that meeting at 6:30 a.m. on Saturday, later than any of us wished, we finally reached agreement on a consensus document that is in the final process of editing and which we hope to have available perhaps by the end of the week for circulation.

This report was designed to provide governments with a range of strategies and options for their analysis and consideration in addressing the issue of climate change. If I were to characterize this meeting in a very short phrase, particularly in the latter hours, though we tried to avoid this scenario, it inevitably really became a kind of warmup for negotiations on this immensely difficult issue. As you know, the President has offered and committed the U.S. to host the first round of such negotiations on a framework convention on climate change probably at the beginning of next year.

We spent about one and a half days at the outset in what we called parallel editing groups in which the ten or so individual chairmen responsible for the RSWG papers underlying the summary convened with the representatives of interested countries and edited the draft policy maker's summary that was provided. The idea then was to spend the next two and a half days in plenary session. As I have indicated, the last day turned out to be not quite a 24 hour session but pretty close to it. We did get agreement at the end of that very long night.

I will not go through the explanation of exactly how the work of this group was structured or the overall IPCC. That is in the record in the statement, and it is easier to explain it through the two figures rather than words in any event.

This working group considered, as you know, Senator, a very wide range of issues in an extremely short time. If one thinks for a moment about the fact that what we are trying to come up with here is a set of response options for worldwide response to this serious issue of climate change, it should come as no surprise that at the end of what for all practical purposes is one year at best, there is a lot of work still to be done.

Since January 1989 we have held many meetings and workshops to analyze and assess the factors involved in considering such response strategies, and we are now at the threshold of this first interim report. I stress interim because that is the way we have always characterized the first report of the IPCC.

At the outset I should make clear that our working group was tasked with providing policymakers a range of potential strategies for addressing climate change—options for addressing climate

change. It was not our task to come forward with a set of recommendations or to assume the policymaker's role with recommendations for specific actions that should be undertaken by governments. Both the chairman of the IPCC and I stressed this point at the outset.

Instead, we have attempted to provide a roadmap, as I have called it, for policymakers and, of course, negotiators that might be involved in the framework climate change convention negotiation, so that they are fully aware of the major issues that they are going to have to face in addressing this extremely complex issue.

The final report of the Response Strategies Working Group, which I will call RSWG or working Group III recognizes the findings of IPCC Working Groups I and II regarding the prospects of future climate change and its associated impacts. As a matter of fact, our draft begins with direct quotations from those two working groups.

Our report also recognizes the difficulty that policymakers face in their decisionmaking process because of the many uncertainties regarding the causes, magnitude, timing and regional impacts of climate change and the lack of understanding, especially in the work of Working Group III of economic costs and benefits that might be associated with the various response strategies and options.

All of these strategies would affect important economic activities such as energy production, transportation, agriculture and so on. Again, I stress that if there was any message that came out of this meeting, it was the extraordinary difficulty that we will have should we be called upon to address this issue in the context of an international negotiation.

The cost of response strategies in terms of reduced output available to satisfy other pressing wants and needs, as emphasized, for example, by the distinguished delegate from China, must be considered in the context of the strategies benefits. The climate change response strategies, the working group noted, will have to take into account the extremely wide variations among countries in terms of how they may be affected by climate change and their relative abilities to limit greenhouse gas emissions or to adapt to climate change.

The potentially serious consequences of climate change on the global environment give us sufficient reasons to begin by adopting response strategies that can be economically and environmentally justified immediately, even in the face of the significant uncertainties. A well-informed population is essential to promote awareness of the issues and provide guidance on positive practices. The social, economic and cultural diversity of nations will require, of course, tailored approaches.

In considering the specific strategies for response, our working group recognized that while we work to improve our understanding of the vital scientific and socioeconomic aspects of this issue and the possible benefits of alternative strategies, the flexible and progressive approach emphasized in our draft report, would be required. The approach stresses those measures that are cost-effective and which yield benefits other than those related to climate change. If that sounds like a rephrasing of the policy as set down

by Secretary of State Baker, as you pointed out, a little more than a year ago that we sometimes refer to as a "no-regret" strategy; then the "no-regret" strategy is one clear area of agreement and consensus which was achieved in this meeting.

Because of the possibility that other long-term actions may be required, the Response Strategies Working Group recognized that certain actions should be undertaken now, which provide the requisite information for making decisions in the longer term.

These of course would include increased research to reduce scientific and economic uncertainties, the development of new technologies in the fields of energy, industry, forestry and agriculture. Finally, because effective responses to climate change may require an unprecedented degree of international cooperation, the RSWG noted that the international community should embark upon the negotiation of a framework convention on climate change as soon as possible after completion of this IPCC interim report.

Mr. Chairman, maybe I will conclude my remarks at this point. I submit the balance of my remarks for the record. We anticipate that this work will continue in the future. One particular area which we have all noted, that requires a great deal of work, in the purview of Working Group III, is further consideration of the various economic and social impacts that different response strategies might hold for different countries in the world.

Thank you very much, Mr. Chairman.

[The statement follows:] /

TESTIMONY OF
DR. FREDERICK M. BERNTHAL

DEPUTY DIRECTOR
NATIONAL SCIENCE FOUNDATION

BEFORE THE

COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION
UNITED STATES SENATE

JUNE 14, 1990

Mr. Chairman, Members of the Committee:

My name is Frederick Bernthal and I am Deputy Director of the National Science Foundation. It is a pleasure to be here today to report on the work of the Response Strategies Working Group (RSWG) of the Intergovernmental Panel on Climate Change (IPCC). I served as head of the U.S. delegation and chaired the meeting of the RSWG last week in Geneva, at which a first assessment report on climate change response strategies was completed. This report provides governments with a range of strategies for further analysis and consideration in addressing the issue of climate change.

Establishment of the IPCC:

As you are aware, the IPCC was established in 1988 under the auspices of the World Meteorological Organization and the United Nations Environment Program to serve as the principal international forum for dealing with climate change. At the IPCC's

first meeting in November 1988 it was agreed that the Panel's work would be conducted in three areas: (1) an assessment of the science of climate change; (2) an assessment of the likely impacts of climate change; and (3) consideration of possible response strategies. Three Working Groups, chaired respectively by the United Kingdom, USSR, and United States, were established to carry out these tasks (see Figure 1).

The U.S. chaired Response Strategies Working Group (RSWG) was given the task of identifying and considering potential options for limiting or adapting to climate change if such action is deemed necessary in light of scientific evidence. At its first meeting in Washington in January 1989, the RSWG agreed that its basic work program would be conducted by four subgroups dealing with: (1) Energy and Industry; (2) Agriculture and Forestry; (3) Coastal Zone Management; and (4) Resource Use and Management. The first two subgroups were charged with considering measures for limiting greenhouse gas emissions from energy, industry, transportation, agriculture, forestry and other sources and exploring possible sinks and how they can be expanded. The latter two subgroups were to consider measures for adapting to the impacts of climate change, e.g. sea level rise or changing agricultural patterns.

The RSWG's overall activities were coordinated by a Steering Committee, which undertook two specific tasks. The first was to

consider possible scenarios of future greenhouse gas emissions patterns in order to provide a basis for further analysis by all three IPCC Working Groups. In addition, the RSWG Steering committee undertook the key task of considering specific mechanisms for implementing responses to climate change. Such implementation mechanisms were reviewed in five areas: (1) Public Information and Education; (2) Technology Development and Transfer; (3) Economic Mechanisms; (4) Financial Mechanisms; and (5) Legal Mechanisms, including possible elements of a framework convention on climate change. Attached at Figure 2 is an organization chart depicting the structure and work plan adopted for the RSWG.

As you can see, the RSWG has considered a wide range of issues in a relatively short time frame. Since January 1989 the RSWG and its Subgroups and Steering Committee task groups have held a series of meetings and workshops to analyze and assess the many factors involved in considering response strategies. The RSWG's first assessment report, which was completed in draft last week and is now being finalized, represents an important first step in providing the international community with an overview of potential response strategies for addressing climate change.

Major Conclusions of the Response Strategies Working Group:

At the outset it is important to make clear that the RSWG

was tasked with providing policymakers with a range of potential strategies for addressing climate change, not for recommending what specific actions could be undertaken by governments.

Instead what the RSWG has attempted to do, and I believe has done successfully, is to provide a "road-map" for policymakers and negotiators so that they are fully aware of the major issues they must face in addressing this extremely complex issue.

The final RSWG report recognizes the findings of IPCC Working Groups I and II regarding the prospects of future climate change and its associated impacts. As you probably know, the impacts analysis of WGII was based on different scenarios of temperature and sea level rise than those generated by WGI. It also recognizes that policymakers face difficult decisions because of the significant uncertainties regarding the causes magnitude, timing, and regional impacts of climate change and the significant lack of understanding of the economic costs and benefits associated with climate change response strategies, all of which would affect important economic activities such as energy production, transportation, agriculture, etc. The costs of response strategies, in terms of reduced output available to satisfy other pressing wants and needs, must be considered in the context of their benefits. These benefits, which also have yet to be analyzed, depend on the difference in the path of climate change resulting from adoption of a particular strategy and the corresponding difference in climate change impacts. In addition,

the RSWG noted that climate change responses will have to take into account the extremely wide variations among countries in terms of how they may be affected by climate change and their relative abilities to either limit greenhouse gas emissions or adapt to climate change.

Finally, policymakers must realize that all three IPCC working groups are basing their analysis on our best estimates of present and future greenhouse gas emission scenarios, climate models with very simplistic representations of extremely complex earth processes and feedback mechanisms, and in many cases very inadequate geophysical, economic, and mitigation technology data bases. Thus, this assessment should only be considered as estimates of potential climate change given the current set of emission scenarios and analytical tools. It is likely that these estimate will change as we gain new scientific knowledge, improve our initial assumptions, and further develop the scientific and economic tools.

The potentially serious consequences of climate change on the global environment give sufficient reasons to begin by adopting response strategies that can be economically and environmentally justified immediately even in the face of significant uncertainties.

A well-informed population is essential to promote awareness

of the issues and provide guidance on positive practices. The social, economic and cultural diversity of nations will require tailored approaches.

In considering specific response strategies, the RSWG recognized that, while we improve our understanding of the vital scientific and socio-economic aspects of this issue and the benefits of alternative strategies, a flexible and progressive approach is required which emphasizes those measures which are cost-effective and which yield benefits other than those related to climate change.

Because of the possibility that other long-term action may be required for the longer term, the RSWG recognized that actions should be undertaken now which provide the requisite information for making such decisions. These include increased research to reduce scientific and economic uncertainties and the development of new technologies in the fields of energy, industry, forestry, and agriculture. Finally, because effective responses to climate change may require an unprecedented degree of international cooperation, the RSWG noted that the international community should embark upon the negotiation of a framework convention on climate change as soon as possible after completion of the IPCC interim report. In considering possible elements of such a convention, the RSWG concluded that it should, at a minimum, contain general principles and should be framed in such

a way as to gain the adherence of the largest possible number and most suitably balanced range of countries while permitting timely action to be taken.

Mr. Chairman, this a brief overview of the activities and findings of the RSWG. The final report of this group, comprising some 200 pages of detailed analysis, should be available shortly and will be provided to this and other interested Communities. The RSWG report, together with the other two Working Group reports, will form the basis for an overall IPCC report which will be drafted next week and considered for adoption at the IPCC's Fourth Plenary Session from August 27-30 in Sundsvall, Sweden.

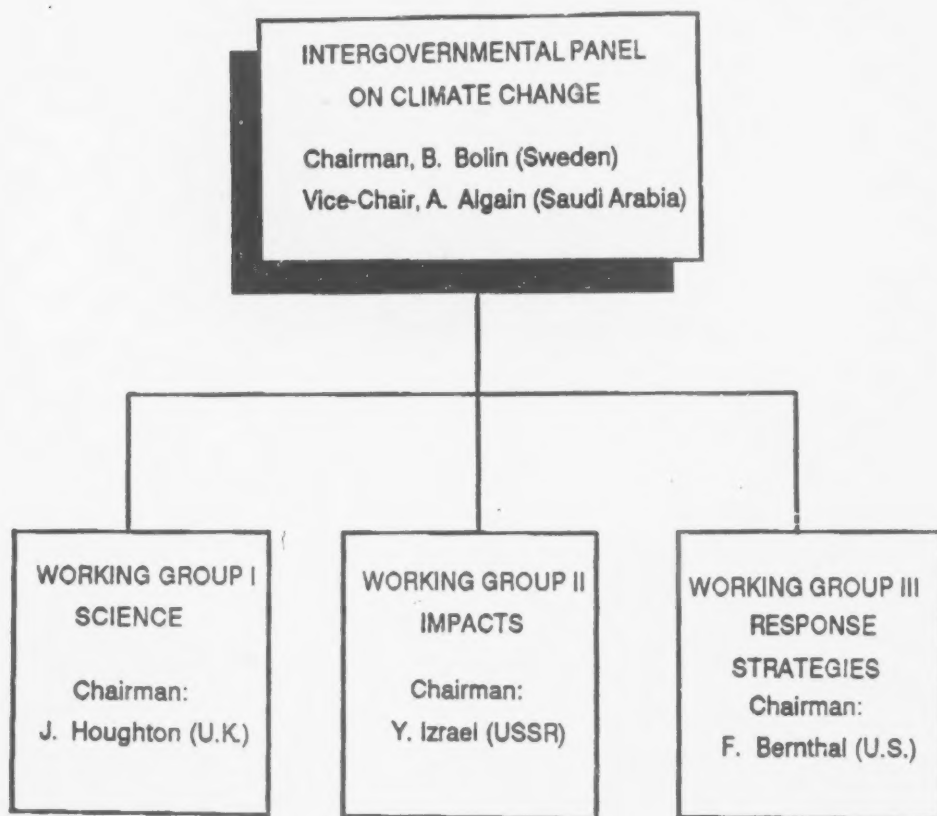
We anticipate that the work of the IPCC and the RSWG will continue in the future in order to more fully assess the response options which have been identified. One particular area for future research is the consideration of the economic costs associated with the various options, which, while an issue of vital importance, could not be addressed in the RSWG's first assessment report given the time constraints involved.

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associated with various measures, which, while an issue of vital importance, could not be addressed in the RSWG's first assessment report given the time constraints involved.

I would like to thank the Committee again for this opportunity to review the work of the Response Strategies Working Group and I would be glad to answer any questions you may have.

FIG. 1



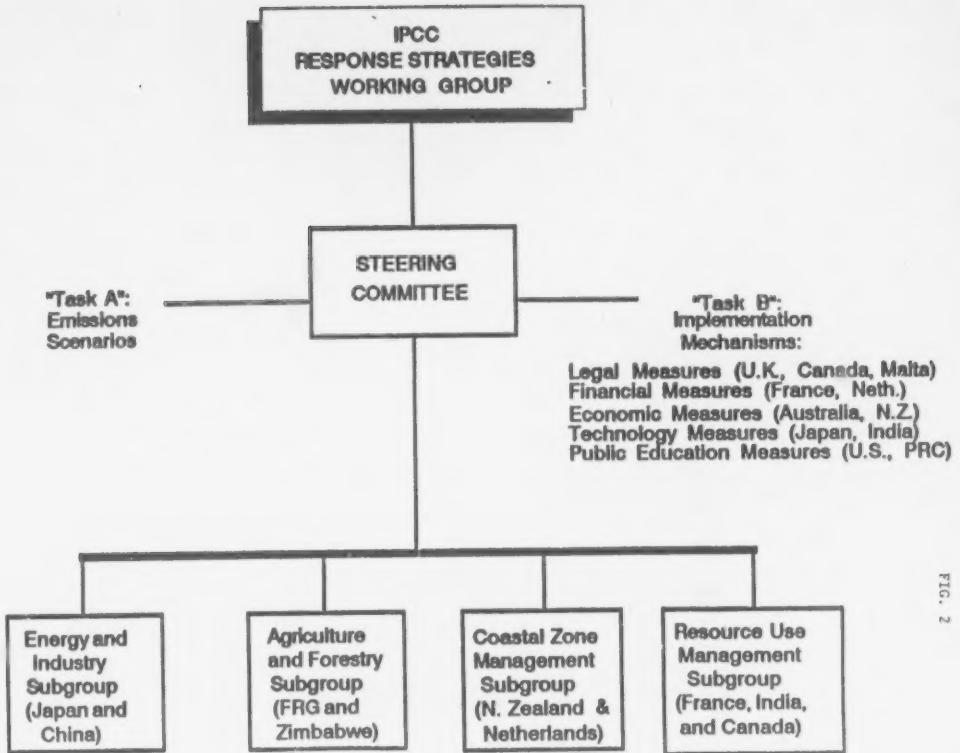


FIG. 2

Senator GORE. Thank you very much, Dr. Bernthal.

We have been joined by Senator Stevens. Welcome.

I think our country is fortunate to have three such talented individuals involved in this process. I know the three of you very well as individuals, and the work you have done in this field. I consider each of you a friend, and I am glad that you are working on this.

Dr. Bernthal, you are in a very tough position, though. You are not able to adopt whatever might be your personal views or preferences. You are charged with pursuing the work within your working group according to instructions that you are given from the White House, and insofar as my questions about what did or did not happen at the meeting are concerned, I want you personally to know that they are directed at you in the full understanding that what was done or not done happened because of instructions you received. My personal regard for you is genuine and quite deep, and I do want you to understand that.

I am quite concerned about the reports which came back to me from the meeting you chaired, because it seems from those reports as if the United States decided not to offer leadership at this meeting. I am told that the most active delegation by far was the delegation from Saudi Arabia, and that on every point the Saudi delegates spoke forcefully and at length with no challenge to their views whatsoever from the United States. Is that essentially correct?

Dr. BERNTHAL. Well, first of all, Senator, I do not wish to characterize the views of individual countries. There certainly was lengthy debate with vigorous expression of opinion coming from a number of fossil fuel producers, especially those in the developing world that rely on exports of fossil fuels for much of their economic growth.

Senator GORE. Is it fair to say that the Saudis spoke more than the delegates from any other nation?

Dr. BERNTHAL. The Saudis were very active. I did not take a count of the number of interventions. They made a number of interventions; that is correct.

Senator GORE. If we had an accurate count of the minutes, would you be surprised if that count showed that the Saudis spoke more frequently than the delegates of any other nation? That would not surprise you, would it?

Dr. BERNTHAL. I suppose it would not. If you have such a count I commend your staff.

Senator GORE. No, I am just asking not about our work but about whether or not you would be surprised if a careful count showed the Saudis were more active than any other delegates. That would not surprise you, would it?

Dr. BERNTHAL. I guess not.

Senator GORE. Now, would it also be fair to say that the U.S. representatives did not challenge any of the views offered by the Saudis?

Dr. BERNTHAL. I am not sure that that is a fair characterization. In fact, I doubt that it is entirely true either implicitly or explicitly.

Again, both with respect to my own delegation and being even-handed, I do not intend to characterize views of individual coun-

tries. The U.S. did not seek to rise to every intervention made by other countries, and if it were to have done so the U.S. would have been monopolizing the floor and it should not do that. Many other countries did not do that, either. So some of these remarks from the countries involved in exporting fossil fuels were not thoroughly challenged from any quarter, as a matter of fact.

Senator GORE. Yes, well I am told by a number of different observers that the United States remained mostly silent while Saudi Arabia dominated the discussion on most of the key points.

I am also advised that the Saudi delegation was directed with active participation by the Ministry of Petroleum and that whereas those officials charged with looking at, among other things, environmental questions, usually direct the policy of Saudi Arabia at such meetings, that the Minister of Petroleum was principally responsible for the policy views expressed at this meeting. Do you know whether or not that is the case?

Dr. BERNTHAL. No, I certainly do not at all, Senator. I have no information on that.

Senator GORE. Well, that is what I am advised, and I will leave the record open if you or your staff wish to challenge that view or have any information to that effect. Do you know what is the official position of Mr. M. E. El-Deghaither of Saudi Arabia?

Dr. BERNTHAL. I do not have it before me here. I regret that I do not, but perhaps one of the staff people that I believe is in the room can come up with that name for me.

Senator GORE. Well, while they are looking for it I would also like to know the positions of Mr. Khalid M. Abuleif, Mr. M. Alai-ban, Mr. M. S. El-Sabban, Mr. A. M. El-Shahri and Mr. A. El-Sheikh, and if your staff can attempt to locate that, that would be very helpful.

Now, the Vice-Chair of the entire IPCC is a Saudi, correct?

Dr. BERNTHAL. That is correct.

Senator GORE. Of course, large petroleum producers might have a self-interest in blocking strong recommendations, or strong policy options, by Working Group Number III. It is therefore somewhat distressing to receive the detailed reports about the Saudi Petroleum Ministry dominating the discussion of the working group that the United States is supposed to chair with very little challenge offered by the United States to the Saudi Petroleum Minister's views. Why did you not include, as a policy option, a specific reduction in emissions by a specific date?

Dr. BERNTHAL. The short answer to that is we never would have reached consensus, Senator.

If I can just respond for a moment, it was not only those countries that rely upon the export of oil that were gravely concerned about specific targets and timetables, for want of a better word, that might be imposed by policymakers from options that were laid out by our group.

Senator GORE. Did you have instructions to oppose specific goals and specific dates?

Dr. BERNTHAL. No, we did not.

Senator GORE. Did we propose any specific goals or specific dates?

Dr. BERNTHAL. No, sir, the U.S. did not.

Senator GORE. Why not?

Dr. BERNTHAL. Because, based on a body of information and recommendations, policy recommendations, including those that to this date in my best understanding are supported by the leaders of our National Academy of Sciences and our National Academy of Engineering, the policy of this Government remains, I think with good reason and with support from those communities, that at this time, given the current state of our understanding, the appropriate response is exactly the one that was enunciated by Secretary of State Baker and of course by the President a number of times since, namely that we have plenty to do, a great deal worthwhile that we can do in addressing this issue, before we launch on what could be massively expensive specific reduction programs.

Senator GORE. Now, wait a minute. What the President has said is that he wanted to wait until the IPCC assessment of the problem was presented. He has said that is the key information we need. We just received it from Dr. Watson. He has just given it to us. The IPCC presented it to the world when Prime Minister Thatcher released their assessment and said it makes it plain the time to act is now. They say that a 60 percent reduction is needed to stabilize concentrations at today's levels.

Now, I do not understand why the working group we chair decided not to even list as an option a 60 percent reduction, or a 50 percent reduction, or some other percentage reduction, so that the nations of the world waiting for this list of policy options could take a look at it.

Instead, you seem to be recommending that we do nothing, and I do not understand. If the United States allows the Saudi Arabian Petroleum Ministry to set the policy on what the world should do to reduce emissions of carbon dioxide, we are not going to get policy options that do anything to reduce carbon dioxide. Do your policy options include any reductions of CO₂?

Dr. BERNTHAL. Well, certainly the final report recognizes that specific timetables and targets, especially within the context of what I refer to as the "no-regrets approach" are actions that especially should be considered at this point by industrialized countries.

Senator GORE. Do you list it as an option. Do you list any reductions as an option?

Dr. BERNTHAL. There is not adopted in the list of options a specific target or timetable, no, because as I have indicated we are not just talking about the U.S. here. I can assure you it would have been a lot longer than 6:30 Saturday morning.

This issue is immensely difficult, and I think it is unfair, quite frankly, to focus on one country as though one country dominated the agenda of that meeting. That simply was not the case.

Senator GORE. Did they speak on every single question, on every one of the major proposals?

Dr. BERNTHAL. I could not say.

Senator GORE. They did.

Dr. BERNTHAL. It is very difficult to answer a question like that because many countries spoke on all issues.

Senator GORE. You see, if you say we could not get agreement, that is one thing. If you say I proposed a specific target for reductions by a specific date and I argued for it and based on my instruc-

tions from the White House I went there to try to get something done. If you say we are going to confront the greenhouse effect with the White House effect so I proposed it, I argued for it, and the other nations of the world just would not buy it, that would be something else again.

But you did not do that because you were instructed not to do that. Instead, the U.S. delegation sat on their hands saying very little while the Saudis and some others blasted any policy option that would have led to reductions.

So I recognize the difficulty that our Nation will encounter in trying to get international agreement, but to not even try is something else quite again.

You know, the impression I have is that the Saudi delegation was really saying what the Bush White House believes.

Dr. BERNTHAL. Senator, really, I have to interject that that carries an implication that I can assure you is just not true. I mean, I was as surprised as anyone. Again, without characterizing a single country, I was surprised that once again at the end of the several days of this meeting there was a reality check, a reality check for the entire world on how vital interests are affected by this issue.

It was again clear that there really are three rather distinct parties when we consider the prospect of going into negotiations. One is the group of developing countries that are extremely concerned about their growth. Some of them are extremely concerned about how they can grow if they are relying on exports of fossil fuels, not just the Saudis but a number of other countries, as you can well understand.

I have sometimes characterized myself as a zealous centrist on this issue. It is not because I cannot make up my mind. It is because I believe it is the right policy. The President himself has said that we should not be driven by the extremes on this issue. It is too important an issue to be driven by the extremes.

There is a second group that clearly has adopted the strategy that I personally believe and our government believes is the correct one of doing some things now immediately; CFC phaseout and the President's reforestation initiative are clearly steps on which we cannot possibly lose on and which everybody understands. On the national energy strategy, I just met with a group yesterday chaired by the Secretary of Energy which is pressing ahead with the clear understanding that one of the issues to be considered as we develop that strategy is the possibility of significant climate change. All of those things reflect the U.S. Government's commitment to what I believe is the appropriate and proper policy.

I outlined two groups and explained where the U.S. stood. It is not a spectrum. It is a three-cornered hat, I guess. The third group, of course, is a group of countries, to be quite candid, which is predominantly Northern European and that, quite frankly in my judgment, is in danger of losing a good part of the developing world in the way that the issue of limitation of emissions is being pressed.

So that is the way I came out of that meeting. It is not so different from the reality check, as I referred to it, that we had last year in May at a similar meeting of the Response Strategies Working Group, and it all sort of came back at us again in this meeting.

So I think the U.S. position as propounded by the U.S. desk was in fact responsible, and the single characterization that I think is accurate of what the U.S. tried to do was simply to be helpful in arriving at the consensus view of this meeting. It was an extremely difficult process.

Senator GORE. You use the phrase "reality check". I view the report of Working Group I as a giant reality check. The President has been saying let us wait, let us do nothing, and let us see what Working Group I has to say about this problem. Well, Working Group I has told us they are certain the problem is real. They are certain that additional warming will occur because of this problem, and they calculated with confidence that reductions are necessary—60 percent to stabilize at today's level.

Now some of the European nations favor reductions to at least stabilize greenhouse emissions. Did they make that proposal at your working group?

Dr. BERNTHAL. Well, we have heard a number of countries, not so much at the RSWG meeting, because I think they all understood that it was unlikely to contribute to the consensus, but at many other forums, including the one in the Netherlands last fall—

Senator GORE. No, I am talking about the working group meeting. Did they make that proposal at your working group?

Dr. BERNTHAL. There really was not an effort at least in the plenary session that I recall. I think this is a fair statement, and I am trying to recall.

Senator GORE. I thought that the United Kingdom formally proposed limiting emissions at least enough to prevent further increases and to include that as a policy option.

Dr. BERNTHAL. Prime Minister Thatcher, as you know, has in fact indicated that by 2005 she would hope to return to the emissions levels, I believe it is, of 1990. The U.K. I am sure, mentioned that, particularly in the editing session that involved a portion of the policymaker's summary of the Energy and Industry subgroup.

Senator GORE. Did the U.S. delegation favor that?

Dr. BERNTHAL. That proposal, of course, relates to the U.K.

Senator GORE. No, I am talking about proposals for including as a policy option in the report of your working group. Did the U.S. support proposals to include among those options stabilizing emissions.

Dr. BERNTHAL. I do not think that particular proposal was ever intended to be included as a specific option because, first of all, it applies to the circumstances of one country. There are various countries that have come up with various numbers.

Now you may be referring to the fact that we have an unfinished piece of business. We were asked as a working group, in fact, by the ministers present at the Noordwijk meeting last November, to explore the possibility of meeting the specific target and timetable proposal from the—well, let us not get into the details; I think the proposal was put forth was in Toronto a couple of years ago. That would be a step toward stabilization. We have not yet finished that job, and, therefore, there was no attempt to take up whether or not that should be put on the table as a specific option because we simply have not yet finished the analysis.

Senator GORE. Did you consider in any way, shape or form including reductions as a policy option?

Dr. BERNTHAL. Within the context of a broad strategy, yes, that countries should proceed now to do the many things—and again I go back to the no-regrets label—that are justifiable for other reasons. I think that is the central theme that runs through this international consensus, and there has been consensus on that for some time even among the developing countries.

Senator GORE. Do you believe that Working Group I did a good job, and do you believe their conclusions are sound?

Dr. BERNTHAL. Yes, sir. I have no reason to question the scientific content of the efforts of Working Group I.

Senator GORE. Are you also certain, as they are, that the problem is real and that these greenhouse gases from human activities will enhance the greenhouse effect and cause global warming?

Dr. BERNTHAL. I am convinced this is a serious issue, as is our government, Senator.

Senator GORE. Are you certain, as Working Group I reports, that the emissions of greenhouse gases resulting from human activities will result in an additional warming of the earth's surface?

Dr. BERNTHAL. I am certain, and I will give you my scientific opinion. I am convinced that, other things being equal—and I always use that phrase—if you continue to inject greenhouse gases into the atmosphere and we can measure the increase of those gases, then we will undoubtedly have warming.

Senator GORE. I do not want to fence with you on it, but I do want to get a straight answer because Working Group I does qualify it with all those things. They say in their report we are certain of this.

Dr. BERNTHAL. Let me say that that reflects a degree of scientific understanding that I do not presume to possess. Despite the fact that I am a scientist, I am not an atmospheric scientist. But the Working Group I reports is the working assumption of Working Group III.

Senator GORE. You have no reason to challenge what they told the IPCC?

Dr. BERNTHAL. No, of course not.

Senator GORE. What is your working group's recommendation for a forum to negotiate a climate convention? Did you address that question? Should it be under the auspices of UNEP, WMO, the General Assembly or what?

Dr. BERNTHAL. Well, we tried to talk about that in the meeting. We did not get very far. It simply is not clear yet exactly what the forum should be. The only thing that is clear is that the President has offered the U.S. as the venue for the first meeting of such a negotiation.

I am repeating what I hear now, but I understand that some countries might prefer that this debate be carried out in the U.N. General Assembly. That is not a view that is shared by the U.S.; I think if you sat through even one of our meetings which are not supposed to be negotiating sessions, you would realize the impracticality of doing that.

Senator GORE. I agree with you. I think it would be a mistake for it to be in the General Assembly.

Where should it be? If your report does not address that question, then I will not pursue it.

Dr. BERNTHAL. Not in detail, no.

Senator GORE. What does your report address?

Dr. BERNTHAL. I wish we had it here in front of us. I actually had prepared a short compendium to give you a sketch of what is contained in the report and the options that are set forth.

Let me respond to the specific point, though, about which we are speaking because it is a very important one. As you must know from previous hearings, the whole issue of legal measures, as we have euphemistically called it, to refer to convention negotiation, has been one of the most difficult and contentious issues here. We have worked through that subject, and we agreed, with consensus, that we would simply attempt to put on the table a roadmap, a clear delineation of the difficult issues with the differing views strongly held by a number of different countries, that will have to be negotiated.

So that is what you will find in our report, and that the legal issues paper actually is not significantly changed from earlier drafts.

Senator GORE. Well, Dr. Bernthal, you tell me if you think I am being unfair in this assessment. We have a report from the Scientific Assessment Group that says we are certain the problem is real, it is extremely serious, we have to do something about it, the time to act is now.

The working group chaired by the United States is called the Response Strategies Working Group. I kind of expected that you would come up with some response strategies, but apparently you did not.

Dr. BERNTHAL. Well, Senator, that is not the case. Let me go through the sketch, if you like, of the various findings that we made.

For example, when the final report comes out, you will find, and some of this seems a little obvious, but nobody has ever tried to sit down and really work it out and put it down on paper, that industrialized and developing countries have a common responsibility in dealing with the issue.

Again, I stress policy options. We do not make recommendations and the Chair of the overall IPCC, Professor Bolin, stressed that point many times. The industrialized countries should adopt domestic measures to limit climate change by adapting their own economies in line with any future agreements that might be reached.

Senator GORE. Say that one again.

Dr. BERNTHAL. That the industrialized countries should take measures to adapt their own economies in line with future agreements—that is, negotiations that might conclude—

Senator GORE. What measures?

Dr. BERNTHAL. Well, there are many economic measures that are outlined in detail.

Senator GORE. You did not list any of them.

Dr. BERNTHAL. For example, energy efficiency in our own country.

Senator GORE. Is that in the report?

Dr. BERNTHAL. Certainly. Yes, of course.

Senator GORE. Okay.

Dr. BERNTHAL. It is also——

Senator GORE. Do you list energy efficiency improvements as a policy option?

Dr. BERNTHAL. Yes, of course, absolutely. I mean, it is listed by the U.S. many times in the President's statements.

Senator GORE. No, no. I am talking about coming out of your working group.

Dr. BERNTHAL. It is in places coming out of this working group. You will find the point made again, that industrialized countries should cooperate with the developing countries in international action. Again, this may not sound so significant, but there was a fair amount of argument over what should follow, and the words as they turned out are more or less "without standing in the way of the continuing economic development of those countries"—that is, of the developing countries.

Emissions from developing countries, it is recognized are growing very rapidly, and they need to grow. That is also recognized in this report, and therefore the developing countries again have a certain responsibility within their own constraints to adapt their own economies to recognize the differing situation in that part of the world.

Let me—this is going to take too long. Let me list a few of the more specific things. Now, you have mentioned improved energy efficiency.

Senator GORE. Did you list specific goals for that?

Dr. BERNTHAL. Well, the words will be something like "improved energy efficiency which reduces emissions of carbon dioxide, the most significant greenhouse gas, while improving overall economic performance and reducing other pollutant emissions and increasing energy security." But, that is taken out of context.

Senator GORE. But "Where's the beef," so to speak? Is there any specific——

Dr. BERNTHAL. Specific targets? No, because every country sitting in that room would have had a different answer. Again, I stress, the problems——

Senator GORE. So basically you just said energy efficiency is a good thing.

Dr. BERNTHAL. That is something every country ought to pursue, yes. Use of cleaner energy sources and technologies, which reduce carbon dioxide while having other benefits with respect to pollutant emissions.

Senator GORE. Cleanliness and efficiency?

Dr. BERNTHAL. That is right. Improved forest management and expansion, where that is possible, of forest areas as reservoirs of carbon. And of course, the phase-out of CFCs. I do not think there is much debate needed there.

Senator GORE. Well, actually, that is not the subject of this hearing but the White House is in danger of completely demolishing the Montreal Protocol because of a pig-headed, obstinate policy that differs with that of every one of our allies and every other nation in the world. But I offer that just as an aside, and you do not need to respond if you do not want to. But go ahead. Yes, except for the United States there is widespread global agreement

that we need to improve the Montreal Protocol and go forward to eliminate ozone-destroying chemicals.

Dr. BERNTHAL. Well, again in fairness I think we should wait and see exactly what the U.S. position—

Senator GORE. I hope it will change, too.

Dr. BERNTHAL. Agriculture is another area. Obviously everyone has some interest in agriculture, but, you can probably imagine, when one talks about agriculture and subsidies, all of the countries that have a vested interest in subsidies for the way they carry out their agricultural enterprise are affected. Elements that are put on the table are livestock waste management, altered use and formulation of fertilizers to affect nitrous oxide emissions, and other changes to agricultural land use that can be implemented without affecting food security. Now, that sounds obvious, but those qualifiers allow us to reach consensus.

Measures that enhance the ability of societies and ecosystems to adapt to climate change, among them are immediate steps to improve the emergency preparedness ability of various countries, disaster preparedness, assessing the areas in their own countries that are at special risk from possible sea level rise, and so on.

Well, I could go on, but I think that gives you a little bit of the flavor, and as I say I regret that we do not have the report to throw on the table here, but I suspect we will by the weekend.

Senator GORE. Well, we have by this point got a very clear sense of what is in it and what is not in it. Did any of the sub-groups of Working Group III propose options for specific reductions in CO₂ emissions and emissions of other greenhouse gases?

Dr. BERNTHAL. Well, again, the principal other greenhouse gas, of course—well, there are two.

Senator GORE. Let us talk about CO₂ first. Did any of your sub-groups—

Dr. BERNTHAL. No. There surely were many discussions, as you can imagine—detailed discussions on that issue, but we still have the task of completing the analysis of the feasibility of reaching some agreement on what the option would even be, such as the feasibility of the option remanded to us by the Noordwijk meeting, and I believe that was 20 percent reduction by 2005 only in the industrialized countries. Of course that leaves out the developing world. That job is not finished, Senator. I would expect that we would finish that sometime this fall.

Senator GORE. Can you describe the instructions you received from the White House before going to Geneva?

Dr. BERNTHAL. Well, what I can tell you is that we essentially proceeded with the policy as the President outlined and the Secretary of State and others have outlined up to this point. There were no particular departures from policy. I think it is well laid out, and my instructions were to proceed with the policy as it is already stated.

Senator GORE. How would you assess the end result of your working group in terms of its usefulness as a blueprint for policy-makers? Does it provide a menu of actions that might really be effective in accomplishing the 60 percent reductions which Working Group I says will be necessary?

Dr. BERNTHAL. It does not establish priorities, I think, if that is what—

Senator GORE. Is it useful to policymakers who would like to do what Working Group I says will be necessary?

Dr. BERNTHAL. I believe it is.

Senator GORE. If every single policy option contained in your working group was adopted, would we meet the goal of 60 percent?

Dr. BERNTHAL. We certainly would not, I suspect, come close to 60 percent. No. I suspect we would easily meet the 20 percent goal in the developing countries—rather, the developed countries, the industrialized countries that we are looking at, but that assumes an effort on the part of all countries in all of these different areas that I mentioned.

Senator GORE. Well, I did not hear a single policy option among those you listed that would result in anything other than marginal changes, unless one assumes a revolutionary commitment to efficiency according to a very broad definition in every sector of society. I mean, I think we need that, but I did not hear anything among the policy options in your report that will actually do anything significant.

Dr. BERNTHAL. Well, I must differ. First of all, let me just say that in the U.S. alone the estimates of the rough impact on our greenhouse gas emissions of the various steps already a part of U.S. Government policy, the improvements that we expect in energy efficiency, the President's reforestation initiative, the benefits of the Clean Air Act and the fact that that will back out a number of the older and less efficient coal plants—all of those steps by some rough estimates that are available and not entirely detailed—will put us 25 percent, by the year 2000, below where we otherwise would have been.

Senator GORE. How much of an increase would that be?

Dr. BERNTHAL. I do not know the exact amount—that will depend upon the economy, of course, but these are projections.

Senator GORE. That would be an increase in greenhouse gas emissions, right?

Dr. BERNTHAL. Yes. These are reductions from where we otherwise would have been, as is the commitment that is being proposed by the Northern Europeans.

Senator GORE. To cite the Clean Air Act as an Administration initiative, when the Administration fought tooth and nail to eliminate any mention of CO₂ in the Clean Air Act, is not the best example of an Administration initiative on the greenhouse effect. But again let me get back to the working group reports.

When will your three reports be finalized within the IPCC process as a part of the final report?

Dr. BERNTHAL. The three Chairs of the working groups are meeting, in fact, next week, as I think you know, in Geneva, and I will be returning to Geneva this weekend. We will be drafting the composite IPCC report at that time. The assumption is that that composite will be available for circulation to all governments early in July. Then the intent is that the various governments will come to Sundsval, in Sweden, at the end of August and we will, I am sure, see the same process repeated that we went through last week in Geneva—review of the document line by line.

If I may make one other comment, though, on your earlier remarks on the significance of efforts that might be undertaken, Senator. I stress that none of the targets and timetables that we have talked about thus far, even those of countries in Europe that have made specific CO₂ reduction commitments—for which in many cases, it is not clear, even to them, how they might achieve the proposed reductions—none of those taken together, even by all of the industrialized world would have a major and significant long-term impact. This is because all of the declarations so far have not really addressed the difficulties of the developing world. I just wanted to make that clear.

Senator GORE. That is yet another reason why I was so disappointed to learn that your Response Strategies Working Group did not address that question.

Dr. BERNTHAL. Well, we did.

Senator GORE. What are the policy options there?

Dr. BERNTHAL. Well, the way in which we address it—and I will refer here now to the comments of the Chair of the IPCC, Professor Bolin, and I agree with him, one of the most valuable things that we hope will come out of this report and be apparent to the reader is how difficult this problem is. If you understand the difficulty of the problem, then, I am sure the policymakers will begin asking the questions about the certainty with which we can proceed.

Senator GORE. Well, with all due respect, if the only thing your working group does is tell us it is a difficult problem, it does not really get us very far along toward a solution for it.

I see where you think your next task ought to be to concentrate on the economic cost of the options that you are including, and that you think it is a service to just describe how hard it is going to be to get an agreement. It is going to be a lot harder if we do not have a list of specific policy options capable of solving the problem.

Under the leadership of the Bush Administration, this working group has failed to give us a list of specific policy options capable of doing what the working group chaired by the United Kingdom says is going to be necessary.

Dr. BERNTHAL. Senator, the Bush Administration and I personally had the task of chairing this group and reaching a consensus among governments. It was not a policy document for the United States of America, nor could we have decided exactly what the content of this document would be.

Senator GORE. Well, of course not, but the United States in chairing the group could have offered some leadership to make some proposals that would have some impact on the problem. Instead, the United States, under the instructions from the White House, sat around, proposed nothing of any significance, and let the Petroleum Ministry of Saudi Arabia control the debate, along with others, and point in the direction of doing absolutely nothing. I just think it is a disastrous result which is a setback for the needed effort to really get moving toward solving this problem.

Now, I promised that we would get you out of here, Dr. Bernthal, and my colleague Senator Pressler has arrived, I just want to note that we promised to get Dr. Bernthal out by 2:30 because they have a major task underway at the National Science Foundation, and so

I will end my questions at that point and recognize Senator Pressler.

Senator PRESSLER. Thank you, Mr. Chairman.

I would like to ask, has the IPCC made any estimates regarding the costs of reducing carbon dioxide emissions in the next century?

Dr. BERNTHAL. No. In fact, Senator, that was one of the problems here in being able to set before policymakers like yourselves a clear exposition of the elements that you would need in order to make a decision. I would submit that for any policymaker it is absolutely essential that he have some idea of what major steps or major initiatives that we do not already know are worthwhile in their own right, might cost.

I would assume that is a given.

Senator PRESSLER. Has the IPCC found definitive evidence of an enhanced greenhouse effect in the past? If not, when do you expect to be able to make a determination about this effect?

Dr. BERNTHAL. Well, I will defer to Dr. Watson on that because that is a scientific question if I may.

Dr. WATSON. The results of Working Group I stated that, although the temperature has increased over the last 100 years, we cannot with certainty ascribe this increase to an enhanced greenhouse effect. By looking at the model projections of temperature change in the future, we believe it would be at least another decade and possibly several decades before we had unequivocal detection of enhanced greenhouse effect.

Senator PRESSLER. How confident is the IPCC in its prediction of the timing and magnitude of temperature changes?

Dr. WATSON. It really is not. The basic problem is this is exactly where the uncertainties are. There are significant uncertainties in the timing and magnitude. Even more, there are significant uncertainties as to the regional patterns of climate change.

What we state, however, is that the models we have today are a fair reflection of how the earth's climate system seems to work. They are our best models, but we fully recognize the large uncertainties in our predictions.

Senator PRESSLER. Thank you very much.

Dr. BERNTHAL. Thank you, Senator.

If I could just make one or two comments here. First of all, for the record, I am informed that the delegation lists from any country, in fact, did not include the titles of delegates, not even the U.S. list.

Secondly, I did want to make the point that the report is consistent with the technical—and I do not mean just scientific, but technical—task of the IPCC and the three working groups. Working Group I did not recommend a 60 percent reduction in carbon dioxide, not to split hairs here. They simply stated as a fact that that is what it would take to stabilize concentrations—

Senator GORE. At today's levels?

Dr. BERNTHAL. I believe that was at today's levels, yes.

Senator GORE. That is correct.

Now in your statement you say that one of the actions that should be undertaken now, really the only one that you cite in your statement, is increased research to reduce scientific and economic uncertainties. Then you go on and on page 7 say one particu-

lar area for future research is the consideration of the economic costs and benefits associated with various measures.

It really is a far cry from what many had hoped would come out of the response strategies working group. Do you believe that a treaty resulting from the negotiation which may begin next year should include specific goals?

Dr. BERNTHAL. Senator, I think that the realities are, and I believe most people would agree with us, that our hands will be very full in negotiating a meaningful framework climate convention. Now it is an unsettled issue, and one which our group did not attempt to resolve despite some jousting, whether negotiation of any protocol that might be associated with the convention should be undertaken in parallel or whether it should go subsequently.

Those are matters that we will put on the table. We will outline the different merits and demerits, the options available, and then it will be up to people like yourselves finally to make those decisions.

Again, I want to stress that many people, I must say, had the wrong expectation. We never had the charge to come forward with a set of recommendations, and that is not just the opinion of Working Group III's chairman but the strong opinion of the Chair of the entire IPCC. Our task, again not to split hairs, was to set forth clearly the information that was available so policymakers could reach their own judgment.

Now in some cases, as you will see when you read the report, the difference between a recommendation and an option is probably not a matter of great substance, but our job was not to establish a set of priorities and say that you must do this and then you must do this and then you must do the following.

Senator GORE. I think it is clear that the U.S. delegation interpreted the task assigned to it in the weakest possible terms, but I agree that you were charged with coming up with a list of policy options. I had hoped you would come up with a list of policy options capable of addressing the problem.

What is so troubling is that Working Group I gives us the most definitive statement yet that the problem is real and serious and must be addressed, but then the working group chaired by the United States fails to even list as options any specific goals, any specific target dates, any specific actions that would really solve the problem.

Dr. BERNTHAL. No one in the world to date has listed any such specific set of responses that would solve the problem. That simply has not been done. The industrialized countries could not begin to solve the problem by themselves.

Senator GORE. I understand that.

Dr. BERNTHAL. There is no such set.

Senator GORE. After the hearing we will give you the list. We had a bipartisan conference here in Washington with delegates from 42 nations which did list policy options, but that is not the subject of this hearing. I would quarrel with you that nobody has done that. It has been done.

Even if it had not been done by others, your working group was charged with doing it. I do not want to prolong this because I did promise to get you out of here, and we are going to keep our prom-

ise. But it is extremely disappointing. It is not entirely surprising because, of course, we had reports in the news media that the administration was instructing our delegates to water this down and make sure that nothing meaningful came out of it. So it was kind of expected.

I want to conclude before you leave by renewing a statement that I made at the beginning. I said this at the beginning because I anticipated that we would have some heated exchanges about the substance of what the working group did not do; but again, I wish to say for the record that I personally would be comfortable if Fred Bernthal was making the decisions about what the U.S. policy ought to be.

I am not prepared to consider what I would do in the difficult position that you are in, getting these instructions from Mr. Sununu and others in the White House who want to do not a darn thing. I have undiminished respect for you personally. I am very disappointed, however, in what the working group accomplished.

Now Dr. Hecht and Dr. Watson, if you can remain for a few more questions, we are going to allow Dr. Bernthal to get back over to the National Science Foundation with our thanks.

Dr. BERNTHAL. Thank you very much.

Senator GORE. Thank you very much, Dr. Bernthal.

Dr. Hecht, when is the draft report from your working group going to be available to us?

Dr. HECHT. All of the reports of these three groups are due in Geneva on June 15, which is today. So I think we should have a copy of the final report by the end of this week, and as soon as I receive it I will be happy to transmit it to you.

Senator GORE. That would be excellent.

Do you, Dr. Watson, have any concern that the results of Working Group I might be watered down in the meeting that begins next week?

Dr. WATSON. No. I have absolute confidence in Drs. Bolin and John Horton who chaired Working Group I that they will give a fair reflection of the science. There is a possibility that I may also be asked to join that delegation. In fact, Dr. Bernthal himself may well ask me to join that meeting next week. That is yet to be decided in the next few hours. I have full confidence that the science will be fairly reflected.

Senator GORE. When the results of Working Group I are meshed into the results of the other two working groups as part of the overall final draft of the IPCC, should we be concerned that at that stage the rather definitive, bold, strong statements you have made be watered down?

Dr. WATSON. No, and I will give you an example of why I am quite confident they will not be watered down. Last week I was in Geneva, as was Dr. Hecht with me. We were there to make sure that Working Groups I and II were fairly reflected in any technical matters in the Working Group III report. As Dr. Bernthal said, the first page of the executive summary of Working Group III recaptured the key conclusions of Working Group I, and they are taken absolutely verbatim. It starts with the statement, "We are certain emissions resulting from human activities", et cetera.

So in fact there is a discussion there of how to reflect Working Group I's results in Working Group III, and there was a decision by all delegations, including the U.S., that the only approach that was acceptable was verbatim quotes.

Senator GORE. Well, that is reassuring.

Which countries were most active, Dr. Hecht, in the meetings of Working Group II?

Dr. HECHT. I think in Working Group II about 10 countries played a dominant role in either leading on the chapters or contributing to the chapters. For the most part they were developed countries. The United States, Canada, United Kingdom, Japan, and the USSR, of course, in leading the effort was co-chair of most of the groups. There was additional input from Algeria for the Sahel region and perhaps one or two other countries.

In my testimony I give you a list of the countries with a number reflecting contributions from other countries around the world. But the dominant effort was concentrated among less than a handful of countries.

Senator GORE. Dr. Watson, what about in Working Group I?

Dr. WATSON. Again, I would say that the main emphasis was indeed from developed countries. We have by far the largest scientific infrastructure. We spend more money on the science, but there was indeed some excellent support from some scientists from developing countries. About 30 countries over all took the lead.

The British took a very major role, but I would say the large preponderance of scientists, as you may well expect, were from the United States. Of the 11 chapters, all but one had a co-chair that was from the United States. I was a co-chair of one of them, and in addition I was allowed to be part of the U.K. core team of only four people that put the draft policymaker summaries together. So the British played a very strong role with very substantial input from the United States.

Senator GORE. Did Saudi Arabia play a very significant role in Working Group I?

Dr. WATSON. At the review process in Windsor only two weeks ago there were indeed two representatives from the Saudi Arabia delegation that made a few interventions, as did many people. But, to be honest, they were a very minor participant in the science assessment.

Senator CORE. That had been my understanding also, and that that was the same in Working Group II.

Dr. HECHT. That was the same in Working Group II. Only at the final meeting in Moscow two weeks ago was there a representative from OPEC, but not of Saudi Arabia at any of the meetings.

Senator GORE. Did the representative from OPEC play an active role in Moscow?

Dr. HECHT. No.

Senator GORE. More or less he served as an observer?

Dr. HECHT. Yes.

Senator GORE. Very good.

Now the next meeting will start when next week?

Dr. WATSON. I believe it will start at 3:00 Sunday afternoon, and continue through Wednesday evening. The key participants will be Burt Bolin as chairman, with Dr. Bernthal from Working Group

III, Dr. Izrael from Working Group II, and Dr. Horton from Working Group I.

There will then be approximately another half dozen people in attendance as well, including Jeff Jenkins from England and I believe Pierre Vallenga from Holland, but I am not sure what the final invitation list is. But it is at the request of Dr. Bolin that the meeting is basically a drafting group to integrate the three reports.

Senator GORE. Now Mr. Algain is second to Dr. Bolin as vice chair of the entire IPCC, correct?

Dr. WATSON. Correct.

Senator GORE. Is he going to be at the meeting next week?

Dr. WATSON. I do not know. I have not heard his name associated with the meeting. But I just do not know.

Senator GORE. All right.

Now when the work is completed on Wednesday, what happens then?

Dr. HECHT. This report that comes out of the Wednesday meeting is called the IPCC Summary, and that is the document that will be transmitted by the IPCC Secretariat to all countries for review. That document and that document only is for discussion at the final IPCC meeting in August in Stockholm. That is the document that will be approved by governments at the meeting.

Underlying that document are the three Working Group reports, which, for the most part, are all complete at this point and not subject to any other revision.

Senator GORE. Between next week and August, there are no official meetings of the IPCC?

Dr. HECHT. That is correct.

Senator GORE. The meeting in August is the 27th through the 30th in Sweden?

Dr. HECHT. That is correct.

Senator GORE. Now at that meeting, what is supposed to take place?

Dr. HECHT. That meeting will review and approve the final IPCC summary, a summary which will integrate all three reports.

Senator GORE. And that integrated report at the end of next August will be the final statement of the IPCC prior to the meeting of a framework convention, correct?

Dr. HECHT. Actually, prior to the meeting of the second World Climate Conference. Which will be at the end of October in Geneva.

Senator GORE. Right. The end of October or the beginning of November.

Dr. HECHT. Correct.

Senator GORE. All right. Very good.

I want to thank both of you for coming. And I thanked Dr. Bernthal earlier. We certainly appreciate your presence.

The hearing will stand adjourned. [Whereupon, at 2:40 p.m., the hearing was adjourned.]

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